ISMPB
International Society *for the* Measurement *of* Physical Behaviour

JUNE 26-28, 2019

6TH INTERNATIONAL CONFERENCE ON AMBULATORY MONITORING OF PHYSICAL ACTIVITY AND MOVEMENT

MAASTRICHT, THE NETHERLANDS

ICAMPAM
MAASTRICHT, NETHERLANDS 2019

ismpb.org

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WELCOME TO ICAMPAM

WELCOME!

After very successful ICAMPAM conferences in Rotterdam, Glasgow, Amherst, Limerick and Bethesda, we are proud to present the next ICAMPAM conference in Maastricht.

This international conference will provide a forum for researchers to discuss the latest developments in physical behavior monitoring using wearable devices. The conference will serve as a meeting point for young scientists and renowned experts in the field of health sciences, engineering, medical sciences, physiology, psychology, sports sciences and more.

The organizing committee paid special attention to create a conference program where many young scientists have the opportunity to present their work. We have chosen for a format where abstract presentations are an essential part of the program, next to keynote and invited speakers, symposia and workshops. This is to ensure the latest science and discoveries are covered. The relatively small-scale (350-450 participants) conference creates a great opportunity for young scientists to easily engage with renowned experts.

Apart from science Maastricht is a city that offers a lot of cultural and social activities. Maastricht is located in the province of Limburg in the South of The Netherlands, near the Belgian and German border. It is the Gastronomic capital of The Netherlands and emerging as a new wine region.

We welcome you to the beautiful city of Maastricht in June 2019.

Best regards, on behalf of the organizing committee,

Guy Plasqui & Kenneth Meier
ICAMPAM 2019 Co-Chairs

WELCOME ON BEHALF OF THE SCIENTIFIC COMMITTEE

For the ICAMPAM 2019 we are very pleased to have on board five excellent keynote and six invited speakers, who all have been chosen based on their important contribution to the research field of monitoring of physical behavior.

The research field has developed dramatically since the first conference that was held in Rotterdam in 2008. This is now demonstrated by the quality of the submitted abstracts. For ICAMPAM 2019 we received many high quality studies and abstracts, which made it difficult to select symposia for presentation and to select between oral and poster presentations.

The scientific committee has consisted of more than 20 people. They have taken part in the selection of keynote speakers and invited speakers, symposia and pre-conference workshops. They have also done a great job with reviewing all submitted abstracts. We have strived for quality also when reviewing abstracts, and each abstract has been reviewed by three persons.

On behalf of the scientific committee I wish you a good and challenging conference with a lot of interaction! That is how we can bring the research field ahead!

Jorunn L Helbostad
Scientific committee leader

WELCOME ON BEHALF OF THE SOCIETY

We have now come a long way since the first ICAMPAM in Rotterdam, organised by Hans Bussmann in 2008. With the formation of the International Society for the Measurement of Physical Behaviour (ISMPB) in 2016 and our journal, the Journal for the Measurement of Physical Behaviour, in 2017 we are now ready to make significant strides in advancing the techniques and applications of our technologies to the wider field. ICAMPAM represents our forum to discuss our existing research and plan future projects with existing and new collaborators.

On behalf of the Society's Board members I wish you all a fun-filled, productive and interesting conference.

Malcolm H Granat
President of the ISMPB

ABOUT ISMPB

The International Society for the Measurement of Physical Behaviour (ISMPB) is a non-profit scientific society which focuses on the issues related to ambulatory monitoring, wearable monitors, movement sensors, physical activity, sedentary behaviour, movement behaviour, body postures, sleep and constructs related to physical behaviours. Therefore the Society specifically focuses on the objective measurement and quantification of physical behaviours which include:

- all free-living physical behaviours (including sleep) in its different forms (volumes and patterns which could give an indication of quality)
- measurements that are unrestricted, prolonged and unsupervised
- measurements of physiological responses (e.g. energy expenditure) that are directly related to physical behaviours
- a wide range of applications: clinical, public health, behavior sciences, end users etc.

The Society aims to promote and facilitate the study and applications of objective measurement and quantification of free-living physical behavior(s) and its related constructs (e.g. energy expenditure, context) using wearable devices. The Society is characterised by:

- its multidisciplinary focus; including engineering, signal analysis, physiology, medical sciences, public health, psychology, ergonomics and sports.
- bringing together people from a wide variety of backgrounds and expertise, including researchers, clinicians, therapists, signal analysts, computational scientists and commercial companies.

ISMPB hosts a biennial International Conference on Ambulatory Monitoring of Physical Activity and Movement (ICAMPAM). The first ICAMPAM Meeting took place May 21 – 24, 2008 at the Beurs-WTC Congress Center in Rotterdam, Netherlands.

The first meetings took place in Rotterdam (2008), Glasgow (2011), Amherst (2013), Limerick (2015), Bethesda (2017).

ISMPB BOARD OF DIRECTORS

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ABOUT ISMPB

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Rick Troiano
Stewart Trost

Podium Conference Specialists

Marischal De Armond
Pam Prewett
Cendrine De Vis

GENERAL INFORMATION

CONFERENCE VENUE

Maastricht Congress and Exhibition Center
Forum 100, 6229 GV
Maastricht, Netherlands
(please review the floor plan at the back of the program for further details)

CONFERENCE REGISTRATION

Registration for the conference includes admission to all sessions, the Opening Reception, lunch on Wednesday and Thursday of the conference, tea/coffee breaks during the conference, and the Evening Banquet.

ADDITIONAL TICKETS

Tickets can be purchased separately for your guests and/or children for both the Opening Reception and the Evening Banquet.

NAME BADGES

Your name badge is your admission ticket to the conference sessions, coffee breaks, meals, reception and banquet. Please wear it at all times. At the end of the conference we ask that you return your badge to the registration desk, or at one of the badge recycling stations.

ICAMPAM Board Members, Exhibitors and Staff will be identified by appropriate ribbons.

DRESS CODE

Dress is casual for all ICAMPAM meetings and social events.

REGISTRATION AND INFORMATION DESK HOURS

The Registration and Information Desk, located in the lobby, will be open during the following dates and times:

Tuesday, June 25	08:00 – 17:30
Wednesday, June 26	08:00 – 18:30
Thursday, June 27	08:00 – 18:00
Friday, June 28	08:00 – 12:45

SPEAKER INFORMATION

For Oral Sessions, each room will be equipped with

- 1 LCD projector
- 1 microphone
- 1 laser pointer

All speakers in Oral Sessions must upload their presentations at least 2 hours prior to their presentation in the Speaker Ready Room located on the first floor outside the auditorium. If you have any questions, please visit the registration desk.

POSTER INFORMATION

Set-up and Removal

There are four Poster Sessions during the conference. Poster presenters must set-up and remove their posters during the following times:

Poster Sessions 1 & 2

Set-up:
Wednesday, June 26 — 07:30 – 08:30

Dedicated time:
Wednesday, June 26 — 12:30 – 14:00

Remove:
Wednesday, June 26 — by 18:15

6TH INTERNATIONAL CONFERENCE ON AMBULATORY MONITORING OF PHYSICAL ACTIVITY AND MOVEMENT
ICAMPAM 2019 – June 26-28, 2019

Poster Sessions 3 & 4

Set-up:
Thursday, June 27 07:30 – 08:30

Dedicated time:
Thursday, June 27 12:30 – 14:00

Remove:
Thursday, June 27 by 18:15

Easy reference Poster floor plans can be found on page 68

CONFERENCE EXHIBITORS

A technical exhibition by seven international companies will take place in 0.2/0.3 Berlin/Copenhagen and 0.6/0.7 Madrid/Lisbon throughout the duration of the conference. Exhibitors will provide a presentation in the Auditorium from 11:30 – 12:30 PM on Thursday June 27th

SOCIETY GENERAL MEMBERSHIP MEETING

The International Society for the Measurement of Physical Behaviours (ISMPB) general membership meeting is scheduled from 17:30 – 18:30 pm on Wednesday June 26th in Auditorium 2. All members of the society and prospective members are encouraged to attend and contribute to the meeting.

MEMBERSHIP

ISMPB
International Society for the Measurement of Physical Behaviour

Membership in ISMPB is open to everyone from around the world involved in the measurement of free-living physical behaviour.

Membership fees support the mission of ISMPB in creating a vibrant community bringing together people from a wide variety of backgrounds and expertise, including researchers, clinicians, therapists, signal analysts, computational scientists and commercial companies.

MEMBER BENEFITS

- Register for Society Meetings at reduced registration rates
- Support a new, young and independent Society
- Become connected with leading experts in the field
- Opportunity to get involved as an ISMPB Committee member
- Vote in annual elections for the Board of Directors
- Stand for election to the Board of Directors
- Eligible for student awards at the Society Meetings (best oral and best poster)
- Access to online resources and conference proceedings
- Opportunity to post news and information on related events

MEMBER CATEGORIES

Regular / Post Doc Members ($150)

Open to any person who is engaged in research related to areas of interest of the Society.

Student Members ($75)

Open to any student enrolled in degree granting programs at institutions of higher education

The ISMPB membership term runs from October 1, 2018 to September 30, 2020

INTERNET ACCESS

Complimentary wireless internet access is available in the MECC

SOCIAL PROGRAMME

Welcome Reception
Maastricht City Hall

Tuesday, June 25

18:30 – 20:00

Join us at the Maastricht City Hall to meet up with old friends and make new ones!

Located in the city center of Maastricht, the Stadhuis was designed by Pieter Post in the 17th century in the style of Dutch classicism. The Maastricht City Hall is the site of the Vrijdag Markt or Friday Market, which takes place on Fridays from 9:00am – 3:00pm.

Delegate admission to the Welcome Reception is included in your conference fees.

Early Career Research Event

Wednesday, June 26

Time: 19:00 – 21:30

Cost: $35 (USD) per person for the bike tour

Get to know Maastricht as a local!

Did you know that there are approximately 17 million people living in the Netherlands and more than 23 million bikes? In the 2019 edition of the Early Career Researcher event we will be doing a bike tour. After a long day of conference, join us on two wheels and get to know the most important sights of the city with a local guide.

Conference Banquet
Rebelle

Thursday, June 27

19:00 – 23:00

The Conference Banquet will be held at Rebelle. Located in an Augustinian Church in the heart of Maastricht, Rebelle is an historical national monument of the 17th century.

Admission to the Conference Banquet is included in your conference fees.

Pub Meet-Ups

Each evening during the conference, delegates are encouraged to meet up with each other at a different pub each night. The meet-up takes place following the days program.

TUESDAY:
CAFE FORUM 1

the Place to Be

Sint Pieterstraat 4, 6211 JN Maastricht

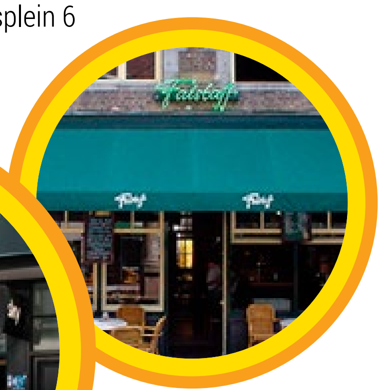
WEDNESDAY:
JOHN MULLINS 2

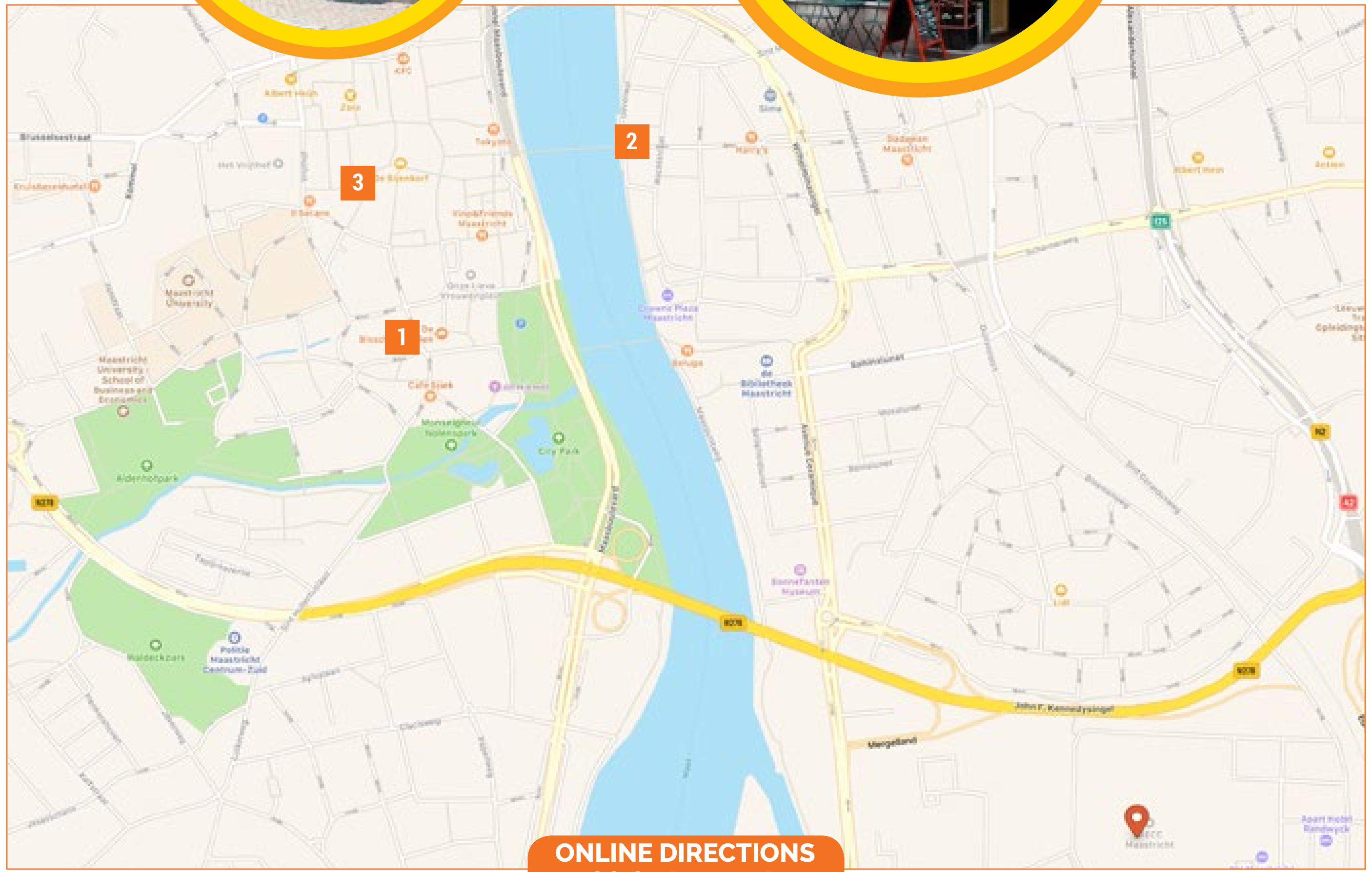
Irish Pub & Restaurant… getting better all the time!

Wycker Brugstraat 50, 6221 ED Maastricht

THURSDAY:
CAFÉ FALSTAFF 3

St. Amorsplein 6





ONLINE DIRECTIONS
bit.ly/31e4tnA

PRE-CONFERENCE WORKSHOPS

Pre-Conference Workshops will take place in the Maastricht University Medical Center

TUESDAY, JUNE 25, 2019

09:00 - 13:00 Morning Session

Workshop Session 1A

Location: Uns50 4.403

Measuring error without error

Sophie Vanbelle[1]

[1]Maastricht University

It is imperative for all measurement instruments to be reliable (provide consistent measurements) and valid (measure what it is meant to measure). Lack of reliability and validity can lead to incorrect conclusions, not replicable research findings and the impossibility, for everyday users of the measurement instrument, to assess changes in behavioural and physical information. This workshop aims to equip researchers studying physical behaviour with the statistical knowledge necessary to plan and perform reliability, agreement and validity studies of measurement instruments providing quantitative information, such as performance tests. At the end of the workshop, participants should be able to 1. make the distinction between the concepts of reliability, agreement and validity. These words are too often used interchangeably in the literature leading to confusion and inappropriate statistical analyses; 2. plan a reliability, agreement or validity study given practical constraints (e.g. number of subjects), particularities of the measurement instrument and study aims; 3. determine which statistical measure(s) is (are) the most appropriate depending on the aim of the study and the study design; 4. interpret the results of the study, communicate the results to an audience with minimum statistical knowledge, and acknowledge the limitations of the statistical approach chosen.

09:00 - 13:00 Morning Session

Workshop Session 1B

Location: Uns50 0.480

Creating context specific accelerometer-based measures

Jasper Schipperijn[1]

[1]University of Southern Denmark

Determining the context in which physical activity or sedentary behavior occurs is important. For example, recent studies have shown that having a job with a high amount of MVPA is related to negative health outcomes, whereas more minutes of MVPA during leisure time or transport are associated with positive health outcomes.

Colleting contextual information using diaries, observations, global positioning systems (GPS) or other devices, and combining it with accelerometer measures, can provide context specific accelerometer-based measures. Recent methodological and technical developments have made it possible to combine contextual and accelerometer data efficiently and create the needed context specific accelerometer-based measures.

The goal of this workshop is to teach participants how to collect contextual information in their accelerometer studies and demonstrate tools that can help create context specific accelerometer-based measures.

09:30 - 11:00 Morning Session

Workshop Session 2A

Location: Uns60 M 4.01

Using sensor-based mHealth technology in early prevention of age-related functional decline: the PreventIT project

Kristin Taraldsen[1], **Beatrix Vereijken**[1], **Mirjam Pijnappels**[2], **Sabato Mellone**[3], **Elisabeth Boulton**[4], **Kamiar Aminian**[5], **Jorunn Helbostad**[1]

[1]NTNU, [2]VU, [3]UniBo, [4]University of Manchester, [5]EPFL

Purpose: The PreventIT project developed a smartphone-delivered activity promotion programme (eLiFE) and tested this in a feasibility randomised controlled trial (RCT) against a paper and pencil delivered programme (aLiFE) versus controls. Both aLiFE and eLiFE integrate exercise into daily life situations. The aim of the workshop is to demonstrate the use of a personalised behaviour change intervention, aimed at young older adults (61-70 years), to prevent functional decline in older age. Rationale: This workshop focuses on how mobile technology (smartphones and smartwatches) can be used to monitor behavior, and to personalise and deliver an intervention. We will discuss the challenges and lessons learned from PreventIT. Objectives: Firstly, we will present the use of mHealth technology methods for assessing functional decline. Secondly, we will present how to implement mHealth technology in the delivery of an intervention. Finally, we will discuss how to modify health-related behaviours through using mHealth technology.

Brief description of the topic: Balance, strength and physical activity are important for healthy ageing and for preventing age-related functional decline, as is maintaining complexity in behaviour. In order to be effective, interventions preventing functional decline should target important risk factors; be individually tailored to the needs and preferences of older adults; and be designed to change behaviour, promoting a healthier lifestyle over time.

Smartphones and smartwatches are used by an increasing number of people of all ages. Because smartphones can send and receive wireless information, and communicate with external servers, they are suitable platforms for delivering individualised interventions with real-time feedback to the user. A plethora of mobile health applications have been developed. However, most of these target younger adults and focus on cardiovascular health. Furthermore, few are evidence-based, which is mandatory if they are to solve health-related challenges.

The PreventIT group has run a feasibility randomised controlled trial (RCT) of a smartphone-delivered activity promotion programme (eLiFE), versus a paper and pencil delivered programme (aLiFE), versus controls, with aLiFE and eLiFE integrating exercise into daily life situations. The aim was to test a personalised behaviour change intervention aimed at young older adults (61-70 years), to prevent functional decline at older age. This workshop focuses on how mobile technology (smartphones and smartwatches) can be used to monitor behaviour and to personalise and deliver an intervention. Tools used in this project will be demonstrated and the discussion will focus on challenges and lessons learned from PreventIT.

Format: First we present the rationale behind the PreventIT feasibility RCT. Then three presentations will present and demonstrate the mHealth technology methods for assessing functional decline; how to implement mHealth technology in the delivery of an intervention; and how to modify health-related behaviours by use of mHealth technology.

11:30 - 13:00 Morning Session

Workshop Session 3A

Location: Uns60 0.09

We need to talk. The absolute basics of getting your device data and other date-time stamped data sources to talk to each other

Elisabeth Winkler[1], **Philippa Dall**[2], **Matthew Buman**[3]

[1]The University of Queensland, [2]Glasgow Caledonian University, [3]Arizona State University

The workshop goals and objectives are:

1. To empower device users with the basic programming skills and confidence to generate new, meaningful measures by combining their detailed device data with other date-time stamped information (e.g., another device, diary-reported sleep/wake times; smartphone data)
2. To achieve this in a manner that is clearly applicable to a variety of devices and other date-time stamped information (e.g., activPAL, actiGraph, smartphone data, diary?)
3. To provide attendees with take-home materials they can use with their own data on their own timeframe in the languages and formats of common software packages that they may be using currently or in the future (e.g., Excel, MS Power BI, SAS, STATA, R?)

PRE-CONFERENCE WORKSHOPS

14:00 - 17:30 Morning Session

Workshop Session 4B

Location: Uns50 4.403

AlPHABET: taxonomy of daily physical behaviours, consensus phase 2

Sebastien Chastin[1], Joruun Helbostad[2], Sebastien Chastin[1], Andreas Holtermann[3], Matthew Buman[4]

[1]Glasgow Caledonian University, Ghent University, [2]NTNU, [3]National Research Centre for the Working Environment, [4]Arizona State University

Description: AlPHABET is an open science project set up to develop a common taxonomy (naming and cataloguing) for classification, harmonisation and storage of objective tracking sensor data of human physical behaviour in daily life. The development will be through an international consensus process. Study and monitoring of daily physical behaviour is a fast emerging science which benefits from the growth in data science and wearable technologies. However, it is limited the lack of shared, standardised and integrated classification system to ascribe meaning to digital data. Each discipline has developed different ontologies and classifications resulting in difficulties in comparing, harmonising and combining knowledge and evidence. Significant progress will be sped up if we can develop a consistent way of describing and classifying human daily activities, physical actions and movements. The first step in developing a universal taxonomy took place at ICAMPAM 2017. This symposium aims at continuing this effort. It will take the form of a debate and interactive session together with a digital consensus process. Report on the current status of the project will be given. This will be followed by new perspectives given by two speakers (M.Buman and A Holtermann). Speakers Jorunn Helbostad: Will chair the symposium and introduce the project aims and protocol Sebastien Chastin: Will report on the outcome of the last consensus meeting and present the updated proposed taxonomy. Matthew Buman: Will present a novel perspective based on 24 hour behaviour analysis, arguing that physical behaviours are not just based on movements. Andreas Holtermann: Will present a novel perspective not represented in the consensus to date. He will reflect on how the taxonomy need to capture the occupational setting. Format The symposium will be in three parts and adopt Delphi approach Part 1: Presentation The Chair will introduce the project and explain its aim, protocol and plan for the symposium. (5 min) Sebastien Chastin will present the outcome of the previous round of consensus at ICAMPAM 2017 and the current taxonomy (10 Minutes) Matthew Buman will present evidence that we might need to consider in the taxonomy physical behaviours that are not based purely on movement. He will give some examples and point to where the current taxonomy can or cannot capture these. He will make some suggestion for improvements. Andreas Holtermann will discuss the current taxonomy in the view of the occupational setting . This is a new perspective that was not represented previously in the consensus. He will give some examples and point to where the current taxonomy can or cannot capture these. He will make some suggestion for improvements. Part 2: Debate The Chair will facilitate a debate based around the naming and cataloguing of daily physical behaviour and the taxonomy. S.Chastin will produce a brief of the Part 3: Digital Consensus An online consensus tool will be used to capture votes about the updated taxonomy, issues raised during the debate and area of priority work to be done. Finally the floor will be opened to volunteer to come and work on the project.

14:00 - 15:30 Morning Session

Workshop Session 5A

Location: Uns60 0.09

Just D.O. It. Using Video-based Direct Observation to Assess Physical Behaviour

John Sirard[1], Sarah Keadle[2], David Bassett[3], Scott Strath[4]

[1]University of Massachusetts Amherst, [2]California Polytechnic State University, [3]University of Tennessee Knoxville, [4]University of Wisconsin Milwaukee

The Goal of this workshop is to develop a preliminary consensus document describing best practices and procedures for performing video-based direct observation

The specific Objectives are to:

1. Expose attendees to different DO systems currently in use through brief formal presentations and documentation (handouts, electronic docs)
2. Provide video-examples of coding scenarios including clear cut transitions and more ambiguous behaviors/postures/intensities/steps. Have participant?s code select portions of videos.
3. Identify important issues for accurate and reliable coding in different populations (children, healthy adults, functionally limited/older adults).
4. Identify primary outcome variables (or metrics) that could be consistent across systems.
5. Discuss key challenges and limitations of DO coding

14:00 - 15:30 Morning Session

Workshop Session 5B

Location: Uns50 0.480

Beyond daily totals, using novel analysis of raw-accelerometer data to generate clinically important outcomes of physical behaviour in free-living populations

Andrew Kerr[1], Kate Lyden[2], Nicholas Smith[2]

[1]University of Strathclyde, [2]PAL Technologies Ltd

The goal of this workshop is to provoke discussion and reflection on the importance of objective measures of free-living physical behaviour for clinical research and patient focussed decision making.

14:00 - 15:30 Morning Session

Workshop Session 5C

Location: Uns60 M 4.01

Intra-abdominable pressure and daily living: How a simple measurement can provide insight into physical behavior and health

Janet Shaw[1], Monika Leitner[2], Robert Hitchcock[3]

[1]University of Utah - Kinesiology, [2]Bern University of Applied Sciences, [3]University of Utah

Intra-abdominal pressure (IAP) provides insight into physical behaviors associated with trunk muscle activity and ventilatory patterns. Recent advancements in measurement have allowed for comprehensive assessment of IAP during human movement. Given the specialized nature of investigating IAP, however, its role in health and disease is not broadly understood. The overall goal of this workshop is to introduce participants to the physiologic measure of IAP, which has been linked to physical activity levels and types as well as to the clinical presentation of pelvic floor dysfunction, most notably urinary incontinence. The presenters incorporate knowledge and perspectives from exercise physiology, physical therapy and rehabilitation, and bioengineering. They will present their experience with developing sensor technology, measuring IAP in a variety of activities and settings, analyzing and interpreting IAP data, and using knowledge of IAP when conducting clinical work in pelvic floor health.

16:00 - 17:30 Morning Session

Workshop Session 6A

Location: Uns50 0.480

How good are our criterion measures for accelerometer developments and validations?

Kong Chen[1], Scott Crouter[2], Guy Plasqui[3], Sarah Kozey Keadle[4]

[1]NIDDK/NIH, [2]University of Tennessee, [3]Maastricht University, [4]California Polytechnic State University

Co-chairs: Kong Chen (NIDDK/NIH kong.chen@nih.gov) and Ed Melanson (U Colo Denver Ed.Melanson@ucdenver.edu) Summary: Accelerometers are widely used to predict energy expenditure and/or physical activity types. We often focus on accuracy and precision of accelerometers for such predictions, but many users do not understand how these two parameters are obtained. During the development of these accelerometers, from the hardware to prediction models, and when they are validated, "criterion measures" are used. Methodologies commonly used as "gold-standards" are indirect calorimetry and direct observations. How accurate and precise are these standards and how are they determined (what do they rely on as the criteria), and how these could impact the accelerometry predictions? In this symposium, each presenter will highlight how criterion measures are calibrated and validated, and how they should be optimized for accelerometry studies, with focus on their advantages and limitations. The overall goal is for the audience to have a better understand these so-call "gold-standards" when choosing to use them for their own development or validation studies. • Metabolic carts (including portable units): Scott Crouter (U Tenn scrouter@utk.edu) Indirect calorimetry is commonly used for metabolic responses in laboratory and field-based research. These systems measure metabolic variables for <4-5 hrs on a breath-by-breath basis or through the use of a mixing chamber. Portable units are now commonly used to develop and validate algorithms to estimate energy expenditure and intensity thresholds for wearable physical activity monitors. For measures of energy expenditure, it is generally expected that metabolic steady state is obtained. However, steady state is generally not obtained in free-living validation studies creating a disconnect between how the prediction algorithms are developed versus being validated and used in practice. • Whole-room indirect chambers: Kong Chen (NIH kong.chen@nih.gov) Chambers are "live-in" metabolic carts. There are currently ~30-40 research centers globally with room calorimeters, most were originally designed and optimized to measure 24-hr energy expenditure with an accuracy of 98% or better ("gold-standard"). Many of these chambers have improved their time resolution from 10-15 mins to 1 min, which can be used to develop and validate portable PA monitors for estimating the rate of activity energy expenditure for variety of PA types and intensities under quasi-free-living conditions in 1-2 days. The limitations of chambers include operational complexities and sensitivity for low-intensity and non-steady state PA's. • Doubly-labeled water: Guy Plasqui (U Maast g.plasqui@maastrichtuniversity.nl) Doubly labeled water (DLW) is considered the gold standard to assess daily life energy expenditure typically over periods of 5 -21 days, depending on the activity level of the population being studied. Even though body movement and energy expenditure are different physiological constructs, by definition, body movement assessed with an accelerometer should always correlate with activity-related energy expenditure. The DLW technique is an elegant methodology as it only requires subjects to collect some urine samples which does not interfere habitual daily activity. The disadvantage is that it only provides a total amount of energy expenditure over the measurement interval without information on activity patterns. • Direct observations: Sarah Keadle (Calpoly skeadle@calpoly.edu). Early direct observation systems involved real-time coding of behavior using paper and pencil. Newer direct observation methods involve camera or video-recorded observations that are coded at a later date- enabling detailed evaluation of reliability and validity of coding within and between coders. Several groups have reported intra class correlates >0.9. Direct observation has been used a criterion for steps, activity intensity, posture, and activity type and location. Limitations are that no standard coding criteria exist so different groups may code the same movement differently, precluding comparison between studies.

16:00 - 17:30 Morning Session

Workshop Session 6B

Location: Uns60 0.09

Application of actigraphy and wearable devices in pharmaceutical research

Jiawei Bai[1], Vittorio Illiano[2], Eve Pickering[3], Jiawei Bai[1]

[1]Johns Hopkins University, [2]Novartis Pharma AG, [3]Pfizer, Inc.

General Abstract: In recent years, various types of actigraphy or wearable devices have been deployed in both observational and clinical studies. While such devices are becoming more and more mainstream in academic studies, they remain rare in the pipeline of pharmaceutical research. Many pharmaceutical companies are working toward supporting label claims with actigraphy, building the necessary expertise via their own pilot studies or in collaboration with universities. The session highlights three of the actigraphy-related challenges in clinical research: how to sensitively detect longitudinal behavior change, how to identify whether the accelerometer was worn by the same person throughout the study, and how to replace gold standard assessments with actigraphy-derived endpoints. Moderated discussion will follow the individual presentations, to facilitate sharing experience and exchanging ideas about how to best make use of the wearable and actigraphy technology in both academic and pharmaceutical research. Chair: Jonas Dorn, Digital Solutions Director, Novartis Pharma AG Detailed Justification: ISMPB aims to be inclusive of researchers from many backgrounds to generate fruitful discussions through the contrast of multiple perspectives. In recent years, the pharmaceutical industry has become interested in using actigraphy to characterize physical behavior of patients in clinical trials to demonstrate the effect of drugs on patients' lives. Yet, researchers from this industry have had very limited involvement in ICAMPAM in the past. We thus propose this symposium to start exchanging experiences between academia and industry. We expect discussions will stimulate further collaboration in many areas of wearable/actigraphy research, prevent reinventing wheels and advance the knowledge of the field. The topic of this session is unique and was never extensively covered in the past ICAMPAM's. Specific topics of speakers: The first speaker, Dr. Jiawei Bai, is an Assistant Scientist in the Department of Biostatistics at the Johns Hopkins Bloomberg School of Public Health. He has many years of experience across many aspects of actigraphy research, including study design, data collection and analysis. He will be presenting a collaborative project with Novartis about identifying and comparing key patterns of raw accelerometry signals among a group of patients and healthy controls. The second speaker, Dr. Vittorio Illiano, is a Data Scientist at Novartis. Having both a master and doctoral degree in computer engineering, Dr. Illiano uses his expertise on sensor data analytics for the next-generation clinical trials. He will be presenting a first-of-a-kind method to detect whether the actigraphy data collected by accelerometers were indeed coming from the same subjects. The third speaker is Dr. Eve Pickering, an Executive Director, Biostatistics, in the Early Clinical Development Group at Pfizer, Inc. With over 20 years of pharmaceutical experience, her primary areas of expertise are clinical and pre-clinical study design, biomarker validation and translation into the clinic, with a focus on imaging and digital technology. Dr. Pickering is going to share her experience of designing and conducting digital technology studies and provide examples of the assessment of digital devices against other clinical and technological gold standard measures. The session thus highlights three of the actigraphy-related challenges in clinical research: How to sensitively detect longitudinal behavior change, how to identify whether the accelerometer was worn by the same person throughout the study, and how to replace gold standard assessments with actigraphy-derived endpoints. Together the three talks provide a big picture about challenges of and considerations for actigraphy in Pharma clinical studies. Outline of moderated exchange: The interactive scientific exchange after the individual presentations aims to provoke thoughts on 1) what can be learned from the current status of using such devices in pharmaceutical research and 2) how academic and pharmaceutical research can benefit each other. The moderator and chair, who are from academia and industry, respectively, will together lead discussion of the two topics in a Question-Answer-Comment format. The moderator for the discussion is Dr. Vadim Zipunnikov, Assistant Professor in Biostatistics at the Johns Hopkins Bloomberg School of Public Health. Timeframe: The Symposium introduction will be 4 minutes. After that, each individual presentation lasts for 12 minutes (10 minutes for presentation and 2 minutes for immediate questions). The moderated interactive scientific exchange will last for 20 minutes.

DETAILED PROGRAM

Please note that the program is subject to change

TUESDAY, JUNE 25, 2019

Morning Pre-Conference Workshops

09:00 – 13:00 Session 1A
Measuring error without error

09:00 – 13:00 Session 1B
Creating context specific accelerometer-based measures

09:30 – 11:00 Session 2A
Using sensor-based mHealth technology in early prevention of age-related functional decline: the PreventIT project

11:30 – 13:00 Session 3A
We need to talk. The absolute basics of getting your device data and other date-time stamped data sources to talk to each other

Afternoon Pre-Conference Workshops

14:00 – 17:30 Session 4B
AlPHABET: taxonomy of daily physical behaviours, consensus phase 2

14:00 – 15:30 Session 5A
Just D.O. It. Using video-based direct observation to assess physical behaviour

14:00 – 15:30 Session 5B
Beyond daily totals, using novel analysis of raw-accelerometer data to generate clinically important outcomes of physical behaviour in free-living populations

14:00 – 15:30 Session 5C
Intra-abdominal pressure and daily living: How a simple measurement can provide insight into physical behavior and health

16:00 – 17:30 Session 6A
How good are our criterion measures for accelerometer developments and validations?

16:00 – 17:30 Session 6B
Application of actigraphy and wearable devices in pharmaceutical research

18:30 – 20:00 **Opening Reception**
Maastricht City Hall

WEDNESDAY, JUNE 26

08:30 – 09:00 **Welcome**

09:00 – 10:00 **Keynote Presentation**
Pedro Hallal *Universidade Federal de Pelotas*
Location: Auditorium 2
Physical activity surveillance worldwide: Past, present and future

10:00 – 11:00 **Oral Sessions 1 – 3**

O.1 Multi-modal assessment
location: 0.8 Rome

O.1.1 Supporting physiotherapy in Parkinson's disease with a remote monitoring system focussed on falls and activity: the Vital@home study
Luc Evers *Radboud University Medical Center; Donders Institute for Brain, Cognition and Behaviour*

O.1.2 Combining accelerometry with GPS-triggered e-diaries to investigate physical activity and mood in adolescent's everyday life
Elena Koch *Karlsruhe Institute of Technology (KIT)*

O.1.3 Feasibility of a sensor based technological platform for inhospital rehabilitation patients
Maartje Hendriks *Sint Maartenskliniek*

O.1.4 Improving physical behaviour monitoring by combining Accelerometry with GPS-location tracking to investigate mental health indicators and to inform real-life interventions
Markus Reichert *Heidelberg University*

O.1.5 Spatial distribution of children?s physical activity in New York City parks: Accelerometer and GPS assessed patterns in low-income and racial/ethnic diverse communities
Claudia Alberico *North Carolina State University*

O.2 Research devices
location: 0.9 Athens

O.2.1 Associations between physical activity and sedentary behaviour accumulation patterns and weight status in children and adolescents: A latent profile approach
Simone Verswijveren *Deakin University*

O.2.2 Heart rate versus accelerometry based physical activity assessment in older adults
Laura Karavirta *University of Jyväskylä*

O.2.3 Description of raw triaxial wrist accelerometer-measured physical activity in mid-age Australian adults
Gregore Mielke *School of Human Movement and Nutrition Sciences, The University of Queensland, Brisbane, Australia*

O.2.4 Standardised accelerometer metrics: Health, global surveillance and moving towards an evidence-base for deriving physical activity guidelines directly from accelerometer data
Alex Rowlands *University of Leicester*

O.2.5 A sequence analysis to examine the transition process between physical behaviours in the workplace: How are these processes linked to cardiometabolic risk factors?
Alexandra Clarke-Cornwell *University of Salford*

O.3 Machine learning/data mining
location: Auditorium 2

O.3.1 Mine the Data, Find the Correlates of Physical Activity: A Cross-sectional Study
Vahid Farrahi *University of Oulu*

O.3.2 User Verification of Actigraphy Data
Vittorio Paolo Illiano *Novartis Pharma AG*

O.3.3 Supervised Learning Models for Energy Expenditure Prediction in Preschool Children
Stewart Trost *Queensland University of Technology*

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O.3.4 Unsupervised learning of behavior changes using raw accelerometry data

Jiawei Bai *Johns Hopkins University*

O.3.5 Building machine learning models using standard tools for detection of postures and physical activities from long-term accelerometer recordings

Kerstin Bach *Norwegian University of Science and Technology (NTNU)*

11:00 – 11:30 Refreshment Break

11:30 – 12:30 Symposia 1 – 3

S.1 Advancing collaborative activity monitor research using open-source tools

Location: 0.8 Rome

Chair: **Greg Welk** *Iowa State University*

Participants

Greg Welk *Iowa State University*

Paul Hibbing *University of Tennessee, Knoxville*

Charles Matthews *US NIH/NCI*

S.2 Challenges and promise of quantifying free-living walking in neurological patients

Location: 0.9 Athens

Chair: **Fay Horak** *Oregon Health & Science University*

Participants

Fay Horak *Oregon Health & Science University*

Silvia Del Din *Newcastle University*

Jeff Hausdorff *Tel Aviv Sourasky Medical Center*

S.3 Novel methods for processing large activPAL device datasets. A review of different approaches to the challenge of effective data extraction.

Location: Auditorium 2

Chair: **Alan Donnelly** *University of Limerick*

Participants

Annemarie Koster *Maastricht University*

Charlotte Edwardson *University of Leicester*

Kate Lydon *KAL Research & Consulting*

Kieran Dowd *Athlone Institute of Technology*

12:30 – 13:15 Lunch and Poster Session 1

13:15 – 14:00 Lunch and Poster Session 2

14:00 – 15:00 Oral Sessions 4 - 6

O.4 Clinical applications (1)

location: 0.8 Rome

O.4.1 Objective quantifiable assessment of nocturnal movements in patients with Parkinson's disease using a wearable sensor

Inbar Hillel *Tel Aviv Sourasky Medical Center*

O.4.2 Accelerometry measured walking cadence and mortality risk among U.S. adults

Pedro Saint-Maurice *National Cancer Institute, NIH*

O.4.3 Is bias due to reverse causality evident in device-based studies of sedentary behavior, physical activity and mortality?

Charles Matthews *National Cancer Institute, NIH*

O.4.4 Gait irregularity as a predictive marker of exertional heat stroke

Mark Buller *United States Army Research Institute of Environmental Medicine*

O.4.5 A home-based mHealth intervention in older cancer survivors to replace sedentary time with intermittent bouts of light physical activity

Cindy Blair *University of New Mexico*

O.5 Gait Analysis

location: 0.9 Athens

O.5.1 Effects of bout size on gait metrics during daily activity

Fay Horak *OHSU*

O.5.2 How can texting affect your walking?

Patrick Crowley *National Research Center for the Work Environment/Aalborg University*

O.5.3 Is every-day walking in older adults more analogous to dual-task walking or to usual walking? Elucidating the gap between gait performance in the lab and during 24/7 monitoring

Jeffrey Hausdorff *Tel Aviv Sourasky Medical Center*

O.5.4 Comparison between accelerometer and gyroscope for the analysis of gait regularity

Marco Rabufetti *IRCCS Fondazione Don Carlo Gnocchi*

O.5.5 Gait speed assessed by a 4-meter walk test is not representative of daily-life gait speed in community-dwelling adults

Mirjam Pijnappels *Vrije Universiteit Amsterdam*

O.6 Algorithms (1)

location: Auditorium 2

O.6.1 Fast and robust algorithm for detecting standing periods using wrist-worn accelerometers

Marcin Straczkiewicz *Department of Epidemiology and Biostatistics, School of Public Health, Indiana University-Bloomington*

O.6.2 Improving hip-worn ActiGraph posture detection with artifical intelligence on a free living dataset

Roman Kuster *Zurich University of Applied Sciences*

O.6.3 Evaluating the performance of bout detection algorithms for wearable sensors: The Transition Pairing method

Paul Hibbing *University of Tennessee, Knoxville*

O.6.4 Active Travel: Identifying periods of cycling using an accelerometer

Craig Speirs *PAL Technologies Ltd*

O.6.5 Visualisation to support automatic identification of time in bed using a thigh-worn accelerometer

David Loudon *PAL Technologies Ltd*

DETAILED PROGRAM

15:05 – 16:00 ## Oral Sessions 7 - 9

0.7 Clinical Applications (2)

location: 0.8 Rome

0.7.1 The contribution of dog walking to daily moderate to vigorous physical activity in dog owners aged ≥ 65 who walk their dog regularly.

Philippa Dall *Glasgow Caledonian University*

0.7.2 Assessing the effect of pain on function via home-based active tasks measured by a wrist-worn accelerometer

Vittorio Paolo Illiano *Novartis Pharma AG*

0.7.3 The optimal threshold of device-assessed physical activity required for weight loss at 24 months: A receiver operating characteristic curve analysis

Danielle Ostendorf *University of Colorado Anschutz Medical Campus*

0.7.4 Sensor-enabled physical activity recognition in children and adolescents with cerebral palsy

Stewart Trost *Queensland University of Technology*

0.7.5 It takes a week to obtain reliable estimates of tremor characteristics: A pilot study in organic and functional tremor patients

Zeus Dominguez-Vega *University Medical Center Groningen*

0.8 Research devices (2)

location: 0.9 Athens

0.8.1 How do body attachment site and signal aggregation metric affect accelerometer-based physical activity?

Jairo Migueles *PROFITH "PROmoting FITness and Health through physical activity" research group*

0.8.2 Consistency of thigh-worn accelerometry data across ActiGraph Gt3x+, Axivity Ax3, and ActivPAL Micro4 devices using the Acti4 software

Patrick Crowley *National Research Center for the Work Environment/Aalborg University*

0.8.3 Automatic estimation of step asymmetry in a split-belt treadmill experiment using high-resolution accelerometry data

Marta Karas *Johns Hopkins University*

0.8.4 Accuracy of processing methods and sensors differs by activity domain in free-living environments.

Sarah Keadle *California Polytechnic State University San Luis Obispo*

0.8.5 Determination of device orientation, wrist of wear and hand dominance using raw accelerometer data

Joss Langford *Activinsights ltd*

0.9 Validations

location: Auditorium 2

0.9.1 Comparing a short physical activity questionnaire with accelerometer measures as criterion validity: The Tromsø Study

Edvard Sagelv *UiT the Arctic University of Norway*

0.9.2 Validation of the VitaBit Sit-Stand Tracker: Detecting sitting, standing, and activity patterns.

Nathalie Berninger *Maastricht University*

0.9.3 Time2Move: Changing the way we assess sleep, physical activity and sedentary behaviour in children

Rachael Taylor *University of Otago*

0.9.4 Validity of a sleep/non-wear algorithm designed for 24-hour wear when applied in a cohort of Swedish older adults wearing the activPAL3TM in a daytime wear protocol

Elisabeth Winkler *University of Queensland*

0.9.5 Validating estimates of sedentary time across multiple domains

Julian Martinez *University of Wisconsin - Milwaukee*

16:00 – 16:30 ## Refreshment Break

16:30 – 17:30 ## Keynote Presentation

location: Auditorium 2

Taija Finni *University of Jyväskylä*

Multimodal sensing of physical activity level during free-living

17:30 – 18:30 ## ISMPB General Members Meeting

18:45 – 20:00 ## Early Career Researcher Event

THURSDAY, JUNE 27, 2019

08:30 – 09:30 ## Keynote Presentation

location: Auditorium 2

Lorenzo Chiari *University of Bologna*

Through the Looking-Glass: observing and changing motor behaviors via mobiles

09:30 – 10:00 ## Invited Speakers

location: 0.8 Rome

Martijn Spruit *CIRO*

The complexity of physical inactivity in patients with COPD

location: 0.9 Athens

Andreas Holtermann *University of Southern Denmark*

How measure physical activity at work – different from during leisure?

location: Auditorium 2

Anisoara Ionescu *Ecole Polytechnique Federale De Lausanne*

Assessing complexity in physical behaviour: what does it tell us?

10:00 – 11:00 ## Oral Sessions 10 - 12

0.10 Special populations - Children

location: 0.8 Rome

0.10.1 Objectively measured physical activity patterns in overweight and obese children; baseline data of a multidisciplinary tailored intervention program

Gabrielle ten velde *Maastricht UMC+*

0.10.2 MOVI-daFIT! Baseline: Physical Activity and Lipid Profile among children 9-11 years old

Rubén Fernández *Health and Social Research Center*

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O.10.3 Comparison of WHO guideline adherence in self-reported vs. accelerometer-measured physical activity among German children and adolescents

Alexander Burchartz *Karlsruher Institute of Technology (KIT)*

O.10.4 Evaluation of laboratory-based and free-living algorithms for energy expenditure estimation in preschool children under free-living conditions

Matthew Ahmadi *Queensland University of Technology*

O.10.5 Longitudinal effects of physical activity patterns on adiposity and fitness from preschool to school-age

Sara King-Dowling *Child Health & Exercise Medicine Program, McMaster University*

O.11 24-hour activity cycle (1)

location: 0.9 Athens

O.11.1 Levels of physical activity, sedentary behavior and sleep among Finnish adults measured 24/7 by a tri-axial accelerometer

Pauliina Husu *The UKK Institute for Health Promotion Research*

O.11.2 Calibration of self-reported physical behaviours among office workers: A compositional data analysis

David Hallman *University of Gävle*

O.11.3 Daily activity levels of undergraduate first-year students: An observational study

Hui Qing Chim *Maastricht University*

O.11.4 Physical-behavior profiles and aerobic capacity: A latent profile analysis of 24-hour time-use composition among Danish workers

Nidhi Gupta *The National Research Centre for the Working Environment*

O.11.5 Estimated effects of replacing sedentary time with walking on risk factors for coronary heart disease and stroke: a cross-sectional compositional data analysis of accelerometer data from the Copenhagen City Heart Study

Melker Johansson *University of Southern Denmark*

O.12 Research technologies

location: Auditorium 2

O.12.1 Evidence of the respiratory magnetometer plethysmography for the estimation of minute ventilation during low to moderate intensities.

Aya Houssein *Ecole normale supérieure de Rennes*

O.12.2 Assessing physical activity using floor vibrations in a smart home setting

Julien Tripette *Ochanomizu University*

O.12.5 Which vertical ground reaction forces variable is most associated with the in vivo 3D hip joint contact forces?

Sónia Alves *Julius Wolff Institute - Charité Universitätsmedizin Berlin*

11:00 – 11:30 Refreshment Break

11:30 – 12:30 Exhibitor Talks

location: Auditorium 2

12:30 – 13:15 Lunch and Poster Session 3

13:15 – 14:00 Lunch and Poster Session 4

14:00 – 15:00 Oral Sessions 13 - 15

O.13 Real world applications (1)

location: 0.8 Rome

O.13.2 Measuring the response to prompts to stand: an exploration of a pilot study of UK office workers

Philippa Dall *Glasgow Caledonian University*

O.13.3 The contribution of commuting to total daily moderate-to-vigorous physical activity

Abolanle Gbadamosi *University of Salford*

O.13.4 Bouts are out: What is the impact of removing the bout requirement from the Physical Activity Guidelines?

Kate Lyden *KAL Research & Consulting*

O.14 Algorithms (2)

location: 0.9 Athens

O.14.1 Comparison of free-living activity classification between sojourns and epochs using a wrist-worn accelerometer

Robert Marcotte *University of Massachusetts Amherst*

O.14.2 Three distinct physical behavior types in fatigued patients with multiple sclerosis

Hanneke Braakhuis *ErasmusMC / The Hague University*

O.14.3 Real-world detection and analysis of locomotion using single wrist sensor: validation and application to a large population

Abolfazl Soltani *École polytechnique fédérale de Lausanne, EPFL*

O.14.4 Population-specific algorithm development: do activity classification models developed in children generalise to the adult population (and vice versa).

Tom Stewart *Auckland University of Technology (AUT)*

O.14.5 A system for data harmonization and federated analysis of accelerometer and GPS data

Jasper Schipperijn *University of Southern Denmark*

O.15 Computer vision/video analysis

location: Auditorium 2

O.15.1 Challenges and opportunities using webcams and time lapse cameras to evaluate physical behaviour in public open space

J. Aaron Hipp *North Carolina State University*

O.15.2 Applying computer vision techniques to predict physical activity from video images

Gregory Dominick *University of Delaware*

O.15.3 Automating direct observations of physical activity in settings using computer vision

Jordan Carlson *Children's Mercy Kansas City*

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O.15.4 From pixels to sidewalks: Using Google Street View and computer vision to create a national sidewalk inventory

J. Aaron Hipp *North Carolina State University*

O.15.5 Insights on free-living behavior from a novel direct observation coding system

Robert Marcotte *University of Massachusetts Amherst*

15:05 – 16:00 **Oral Sessions 16 - 18**

O.16 Real world applications (2)

location: 0.8 Rome

O.16.1 Self-perceived gait stability modulates the effect of daily-life gait quality on falls in older adults

Roel Weijer *VU Amsterdam*

O.16.2 Context matters - The effect of context-specificity on the association between the built environment and physical activity in individuals with and without health-related problems

Nicole Stappers *Maastricht University*

O.16.3 Habitual physical activity patterns of vocational education students and the association with executive functioning: The PHIT2LEARN study

Jérôme Gijselaers *Open University of the Netherlands*

O.16.4 Monitoring of walking performances of ten non-professional athletes during the 2018 Berlin 100-km Mammutmarsch

Marco Rabufetti *IRCCS Fondazione Don Carlo Gnocchi*

O.16.5 Physical activity and sedentary patterns of semi-nomad pastoralist Senegalese Fulanis are deeply altered in urban context.

Maël Garnotel *CRNH Rhone-Alpes*

O.17 Upper limb monitoring

location: 0.9 Athens

O.17.1 Development of a taxonomic structure to support automatic recognition of eating behaviors

Kyle Winfree Northern Arizona University

O.17.2 Daily activity monitoring of robotic arm support users with muscular weakness

Johannes Essers *Maastricht University Medical Centre+*

O.17.3 Validity of the Apple Watch® for monitoring push counts in people using manual wheelchairs

Sjaan Gomersall *The University of Queensland*

O.17.4 How does the upper limb activity of adolescents with upper limb absence differ from anatomically intact adolescents, and does this change during sport?

Alexandra Clarke-Cornwell *University of Salford*

O.17.5 `Towards an activity tracker for wheelchair users

Herwin Horemans *Erasmus MC*

O.18 Assessment of sleep

location: Auditorium 2

O.18.1 Comparison of non-wear and sleep detection algorithms in ActivPAL data

Norman Wirsik *Leibniz Institute for Prevention Research and Epidemiology - BIPS*

O.18.2 Can accelerometry data alone detect sleep stages?

Michelle Trevenen *University of Western Australia*

O.18.3 Validation of a count-scaled algorithm to assess sleep in children using polysomnography

Kim Meredith-Jones *University of Otago*

O.18.4 OpenCoDa: Advancing compositional analysis of 24-hour time use and movement behaviour data through open science

Sebastien Chastin *Glasgow Caledonian University, Ghent University*

O.18.5 Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity

Vadim Zipunnikov *Johns Hopkins Bloomberg School of Public Health*

16:00 – 16:30 **Refreshment Break**

16:30 – 17:30 **Keynote Presentation**

location: Auditorium 2

Roy Raymann *Sleepscore Labs*

Will Consumer Sleep Technologies change the way we measure sleep in field studies

19:00 – 23:00 **ICAMPAM Banquet**

location: Rebelle

FRIDAY, JUNE 28, 2019

08:30 – 09:30 **Keynote Presentation**

location: Auditorium 2

Emmanuel (Manos) Stamatakis *Sydney University*

Physical activity and sedentary behaviour change: drowning in a sea of possibilities?

09:30 – 10:00 **Invited Speakers**

location: 0.8 Rome

Sebastien Chastin *Glasgow Caledonian University*

24 hours movement behaviour: Concepts, analytics and futures

location: 0.9 Athens

Sophie van Belle *Maastricht University*

Modeling 24h activity patterns using random effects zero-inflated beta-binomial models

location: Auditorium 2

Vincent van Hees *Independent Consultant*

An open heuristic method that helped to gain new insights in human sleep

10:00 – 11:00 **Oral Sessions 19 - 21**

O.19 Special populations

location: 0.8 Rome

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O.19.1 The relationship between gait cadence variability and mobility impairment in acute stroke patients
Andrew Kerr *University of Strathclyde*
O.19.2 The effects of multiple sclerosis on community ambulation: Beyond reduced activity
Inbar Hillel *Tel Aviv Sourasky Medical Center*
O.19.3 Week and weekend day cadence patterns long-term post bariatric surgery
Malcolm Granat *University of Salford*
O.19.4 Added value of a within-subject approach of stress and physical behaviour in stroke patients
Johannes Bussmann *Erasmus MC University Medical Center*
O.19.5 Comparison of upper limb use in people with different levels of upper limb impairment early post-stroke
Sandra Brauer *University of Queensland*

O.20 24-hour activity cycle (2)

location: 0.9 Athens

O.20.1 One Million Days of Mortality: An open science federated analysis of the impact of daily time use on health
Duncan McGregor *Glasgow Caledonian University*
O.20.2 Issues with analysing complex 24-hour accelerometry data to assess sleep, sedentary time, and physical activity
Rachael Taylor *University of Otago*
O.20.3 The ProPASS multi-dimensional 24-hour movement behavior construct
Andreas Holtermann *National Research Center for the Work Environment/Aalborg University*
O.20.4 Sleep versus activity versus sedentary time: A non-parametric approach to isotemporal substitution regression
John Staudenmayer *University of Massachusetts Amherst*

O.21 Consumer technologies

location: Auditorium 2

O.21.1 Validation of the Walk@WorkApp + MetaWearC motion sensor for real time measurements of occupational sitting, standing and movement.
Judit Bort-Roig *Universitat de Vic*
O.21.2 A comparison of Smartphone-based and Accelerometer-based physical activity measures in bipolar disorder
Holger Hill *Karlsruhe Institute of Technology (KIT)*
O.22.3 Development of a GPS measurement based smartphone application to conduct outdoor walking sessions in peripheral artery disease patients
Alexis Le Faucheur *Ecole normale supérieure de Rennes*
O.22.4 Validity of consumer monitors for estimating steps in youth
Scott Crouter *The University of Tennessee Knoxville*
O.22.5 Examining the congruence of relative exercise intensity estimates between chest and wrist worn hear rate monitors
Gregory Dominick *University of Delaware*

11:00 – 11:30 Refreshment Break

11:30 – 12:30 Keynote Presentation

location: Auditorium 2
Frank Scheer *Harvard Medical School*
Circadian rhythms, sleep and physical activity

12:30 – 13:30 Symposia 4 – 6

S.4 Doubts About Bouts: Time in bouts of MVPA fails to characterise patterns of physical activity
Location: Auditorium 2
Chair: **Joss Langford** *Activinsights*
Participants
Melvyn Hillsdon *Exeter Universiy*
Brad Metcalf *Exeter University*
Alex Rowlands *University of Leicester*
Joshua Twaites *Exeter University*

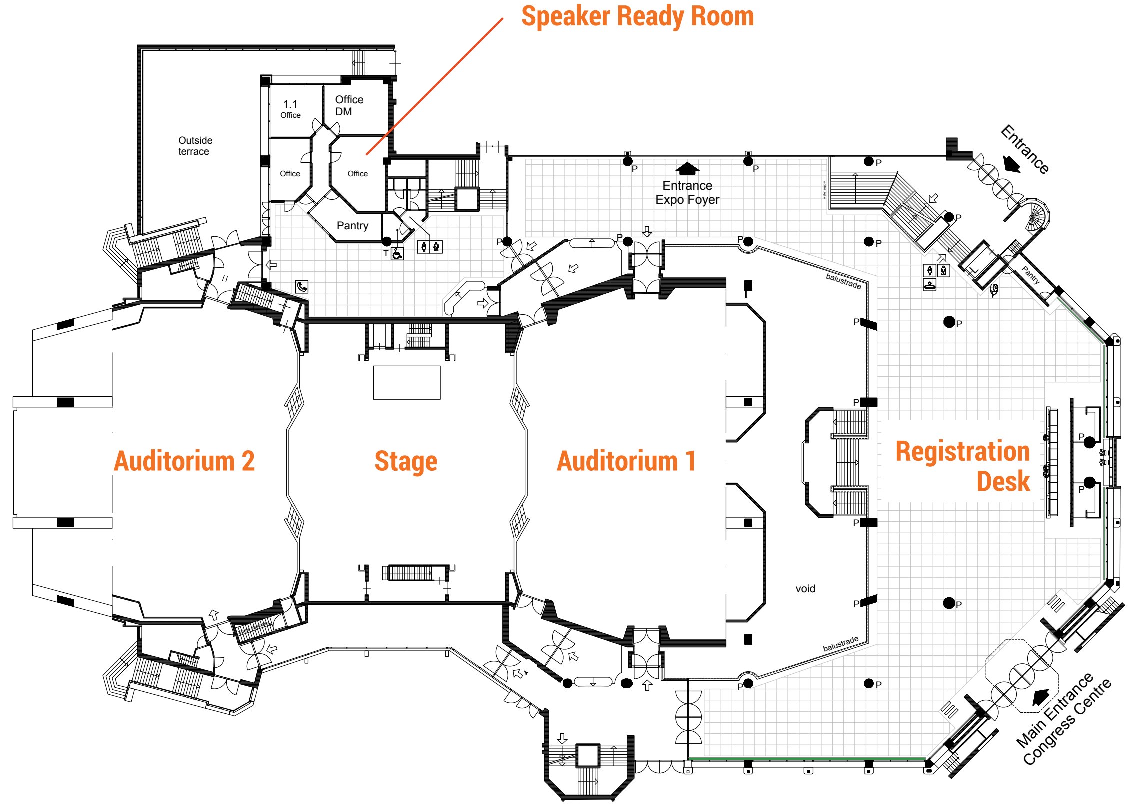
S.5 Both the day and night matter: application of wrist, chest and thigh worn accelerometers to identify 24-hour activity patterns
Location: 0.8 Rome
Chair: **Sari Stenholm** *University of Turku*
Participants
Tuomo Nieminen *National Institute for Health and Welfare, Finland*
Anna Pulakka *University of Turku*
Timo Rantalainen *University of Jyväskylä, Finland*
Miriam Cabrita *Roessingh Research and Development*

S.6 Beyond wearable sensing: Innovative approaches to measure physical behaviour in the management of chronic diseases
Location: 0.9 Athens
Chair: **Miriam Cabrita** *Roessingh Research and Development*
Participants
Miriam Cabrita *Roessingh Research and Development*
Japp van der Waerden *Eindhoven University of Technology*
Kostas Konsolakis *University of Twente*
Harm op den Akker *Roessingh Research and Development*

13:30 – 14:00 Closing Remarks

MEETING FLOOR PLAN

FIRST FLOOR



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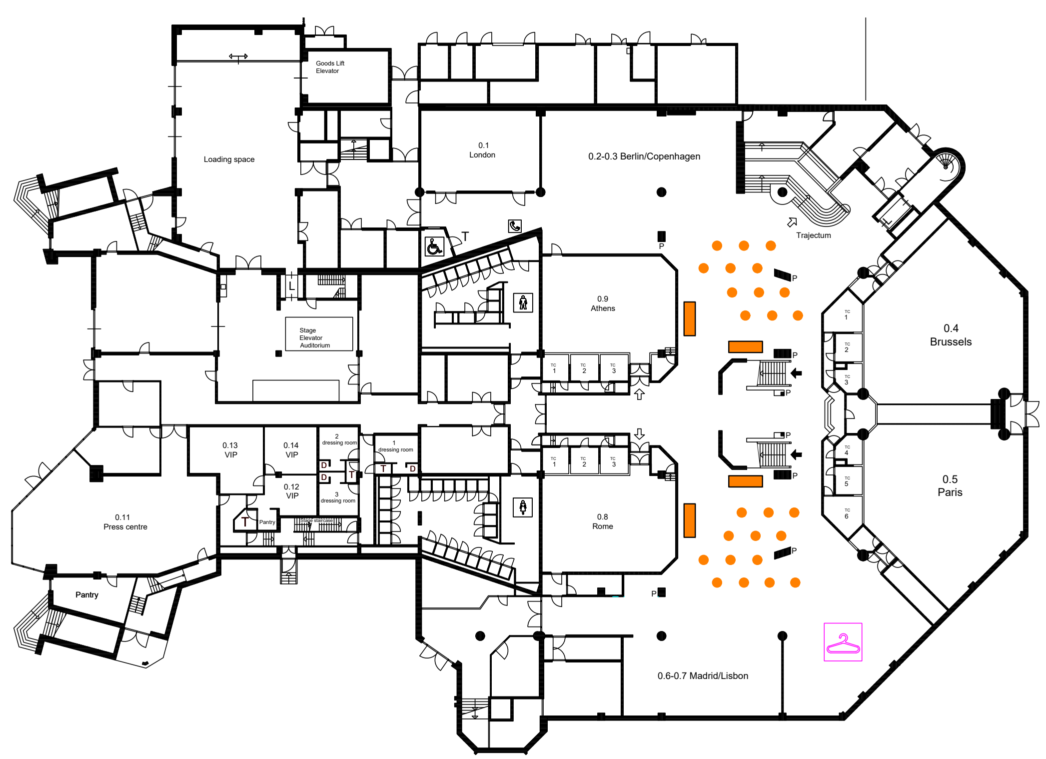

KEYNOTE SPEAKERS

Pedro Hallal *Universidade Federal de Pelotas, Brazil*

Pedro Hallal is the President of the Federal University of Pelotas, Brazil. His research focuses on physical activity and health, with five interrelated themes: (a) physical activity levels, trends and measurement; (b) determinants of physical activity; (c) health consequences of physical activity ; (d) physical activity interventions; (e) global action for physical activity promotion. Pedro has published over 400 peer-reviewed articles, which were cited over 40,000 times, leading to a Google Scholar H-Index of 82. He was the leader of the Lancet Physical Activity Series published in 2012 and 2016.

Physical activity surveillance worldwide: Past, present and future

Physical inactivity is pandemic worldwide. Over 5 million deaths every year are attributable to physical inactivity. Surveillance of physical activity levels worldwide is a key public health priority. Standardized information using self-report are available for most countries around the world. Yet, data gaps are still observed, and little data on time trends are available. Unfortunately, standardized information on national physical activity levels collected through accelerometry is still scarce. The Global Observatory for Physical Activity (GoPA!) is collecting information on physical activity surveillance, research and policy for all countries around the globe. The main objective of the keynote will be to propose strategies to improve the surveillance of physical activity worldwide, both in terms of quantity of countries covered and in terms of quality, particularly on how to increase the number of countries with data collected through accelerometry. Strategies for engaging stakeholders will be presented.

Taija Finni *University of Jyväskylä, Finland*

Prof. Taija Finni completed her doctorate in biomechanics at the University of Jyväskylä in 2001 and post-doctoral studies at the University of California. Prof Finni's research ranges from basic neuromuscular function to translational research related to physical activity and sedentary behavior. Regarding physical activity field she has studied daily EMG activity patterns in antigravity muscles that have the potential to short-circuit the detrimental physiological processes of sedentary time and result in better cardio-metabolic risk profile. By measuring EMG from adults and children her group has gained accurate individual-level knowledge of the sedentary behaviour that is needed for designing effective interventions for different groups. Another research line focusing on muscle-tendon neuromechanics has provided fundamental information on tendon properties and muscle-tendon function for exercise training, rehabilitation and insight into age-related changes in mobility and neuromuscular performance. She has over 90 peer-reviewed publications and has supervised 9 PhD students to completion and has 6 PhD students currently under supervision. She serves as a senior section editor in Scandinavian Journal of Medicine and Science in Sports and is a member of editorial board in Clinical Biomechanics. She is an elected council member of the International Society of Biomechanics and a member of scientific committee of the European College of Sport Sciences.

Multimodal sensing of physical activity level during free-living

Physical activity is defined as any bodily movement produced by the contractile activity of skeletal muscles that substantially increases energy expenditure (Caspersen et al. 1985). My group has measured contractile activity from the main locomotor muscles using non-invasive surface electromyography (EMG) during free-living from children, adults and elderly. This lecture will highlight our research characterizing the levels of muscle activity in different movement tasks and during free-living (e.g. Tikkanen et al. 2013) where even brief, but frequent bursts of muscle activity are necessary to maintain a healthy metabolism (Pesola et al. 2015). I will also discuss how muscle activity recordings compare with energy expenditure, heart rate and accelerometer recordings (Tikkanen et al. 2014) and how different exercise modalities are captured by EMG (Finni et al. 2016). A particular strength of EMG is its ability to capture muscle activity even in sedentary behavior and show variability between individuals in low levels of activity such as standing. This knowledge about the range of individual behaviors may be relevant when designing exercise interventions (Pesola et al. 2016). Recently, we have focused to understand children's sedentary behavior using EMG (Gao et al. 2018) and the updated results from the CHIPASE-study (Children's physical activity spectrum: daily variations in physical activity and sedentary patterns related to school indoor physical environment) are discussed. While the main focus will be on muscle activity assessments, I will share results on new sensor fusion technology that is used to characterize biomechanics of locomotion during free-living in outdoor environments (OPENKIN-project, https://staff.jyu.fi/Members/finni).

References:

Caspersen et al. 1985 Public Health Rep. 100(2):126-31
Finni et al. 2016 AIMS Public Health. 6;3(4):702-721.
Gao et al. 2018 PeerJ. 21;6:e5437.
Tikkanen et al. 2013 PLoS One. 8(1):e52228.
Tikkanen et al. 2014 Med Sci Sports Exerc. 46(9):1831-9.
Pesola et al. 2015 Med Sci Sports Exerc. 47(6):1188-96.
Pesola et al. 2016 Appl Physiol Nutr Metab. 41(11):1155-1162

Lorenzo Chiari *University of Bologna, Spain*

Professor Lorenzo Chiari, Professor of Biomedical Engineering, Department of Electrical, Electronic and Information Engineering (DEI) and Director, Health Sciences and Technologies Interdepartment Centre for Industrial Research, University of Bologna, Italy. Lorenzo is a leading researcher and conducts his research in the field of biomedical engineering. His research interests are directed in particular to rehabilitation technologies, active and healthy ageing, functional evaluation of movement and the risk of falling with wearable sensors, neurobiomechanics of posture and movement, in physiological and pathological conditions. Lorenzo is leading member of eHealth thematic groups of the University of Bologna and has been the principal investigator on EU funded projects on ICT for ageing and wellbeing, and personalized and at-home rehabilitation of people with Parkinson's Disease.

Through the Looking-Glass: Observing and changing motor behaviors via mobiles

The global population is ageing, and there is a need for health solutions that keep older adults independent longer. With increasing access to mobile technology, such as smartphones and smartwatches, the development and use of mobile health applications are rapidly growing. To meet the societal challenge of changing demography, mobile health solutions are warranted that support older adults to stay healthy and active, and that can prevent or delay functional decline. This talk will exemplify a number of promising applications where smartphones and smartwatches have proved successful in observing and changing motor behaviors in older adults. After outlining what we have learned so far from mobiles when monitoring real-world mobility, that we could well qualify as 'mobilomics', we will present some ideas on how this same technology can be used to promote safer movements and encourage active and healthy ageing.

Roy Raymann *Sleepscore Labs, USA*

Roy Raymann, PhD is Vice President, Sleep Science and Scientific Affairs at SleepScore Labs. He is a passionate researcher (PhD) and a product driven thought leader in the field of sleep. As a leading researcher in the field of sleep science, Dr. Raymann spent more than a decade in academia studying sleep at the Netherlands Institute for Neurosciences, before joining the private sector. His recent experience includes leading the sleep related health efforts at Apple (Night Shift, Bedtime, Health- & Research- Kit) and serving as a Sleep Thought Leader of the consumer sleep division at Philips Research where he founded the Sleep Experience Lab.

Dr. Raymann holds a PhD in Life Sciences from Vrije University Amsterdam and was recognized in the Netherlands with an award of Best PhD Thesis in Sleep Medicine. His research and post-doctoral work spans almost 25 years and encompasses multiple publications in peer-reviewed journals, book chapters, speaking events and patents. In addition, Dr. Raymann serves as an ad hoc reviewer for several sleep journals, including SLEEP and Journal of Sleep Research and was editor of the Dutch Sleep Annuals. Since 2018 he serves the Consumer Technology Association Workgroup on Sleep Tracking Consumer Technology Devices, defining the standards for consumer sleep technologies.

At SleepScore Labs he is heading the collaborations with industry, academia and clinics, heading the research, data analytics and sleep wellness program, leading the scientific advisory board and oversees the scientific rigor of the SleepScore Brand.

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Twitter: *@Rraymann*

Will Consumer Sleep Technologies change the way we measure sleep in field studies

Objective sleep measurement is no longer the exclusive domain of sleep clinicians and scientists. A wide variety of consumer sleep technologies (CST), ranging from apps on mobile devices, head bands, wrist worn trackers, in-bed sensors to nightstand monitors are available. Although both Polysomnography and Actigraphy are considered the preferred validated measures for sleep in research, the CST have entered the research community and are frequently used in studies as the single standard of sleep measurement. CST are relatively inexpensive to include in a study as compared to the traditional sleep measures and supposedly give more accurate (objective) information as compared to self-reported sleep data.

The list of new CST is overwhelming and the biggest challenge concerns the validity of the CST; only a limited number of CST have published validation results against the gold standard. The Consumer Technology Association (CTA) and the National Sleep Foundation (NSF) have recently published a standard for measuring sleep using CST and try to set a standard for the industry for the accuracy of CST.

The biggest opportunity is to enrich any dataset with objective sleep recordings, as opposed to self-reported sleep metrics, every single night, month after month, acquired in an at-home setting. This will deliver new insights on sleeping at home, based on big data, taking us beyond data collected from the sleep laboratory that lacks ecological validity.

An overview of the current state of the art of sleep tracking will be given and opportunities and challenges will be discussed.

Frank Scheer *Harvard Medical School, USA*

Frank A.J.L. Scheer, PhD is an Associate Professor of Medicine at Harvard Medical School (HMS) and the Director of the Medical Chronobiology Program at Brigham and Women's Hospital (BWH), Boston. Dr. Scheer's work focuses on influences of the endogenous circadian system and its disruption—such as with shift work—on cardiovascular, pulmonary, and metabolic regulation and disease states, such as hypertension, asthma, obesity and diabetes. Since 2005, Dr. Scheer has been funded continuously as Principal Investigator by the National Institutes of Health (NIH). Dr. Scheer has received numerous scientific awards, including the Young Investigator Award by the American Academy of Sleep Medicine, the Neal Miller Award by the Academy of Behavioral Medicine Research, and the Outstanding Scientific Achievement Award by the Sleep Research Society. He is an Editorial Board Member of several peer-reviewed journals, including the American Journal of Cardiovascular Disease, the Neurobiology of Sleep and Circadian Rhythms, and Journal of Biological Rhythms. Dr. Scheer is a Board Member of the European Society of Biological Rhythms and Member of the Program Committee of the Associated Professional Sleep Societies.

Circadian rhythms, sleep and physical activity

Sedentarism and poor diet, pervasive in our modern society, are thought to be the primary lifestyle factors that have driven the increasing epidemic in diabetes, obesity, and other morbidities. Consequently, lifestyle-based treatment approaches to improve health are targeting improvements in physical activity and diet. Despite concerted efforts to develop and implement activity and diet-based interventions, the ongoing epidemics suggest additional modern lifestyle factors should be considered as culprits, offering novel opportunities for interventions. Two factors stand out: pervasive insufficient sleep and circadian disruption.

Sleep: it occupies a third of our lives, is evolutionary conserved, and its deprivation is lethal. These observations suggest sleep subserves an absolutely critical function(s). Sleep is regulated by two primary processes: a homeostatic and a circadian process. The latter is regulated by the circadian timing system which coordinates physiology and behavior (including, but not limited to sleep) to optimally anticipate the daily changes in environmental and behavioral demands. The circadian system is a multi-oscillator system, composed of the master pacemaker in the suprachiasmatic nucleus and peripheral oscillators in virtually every cell of the body.

Here, I will discuss the interplay between the circadian system, sleep and physical activity; the effects of sleep deprivation and circadian disruption on impaired glucose control, increased blood pressure, increased inflammatory markers, and changes in energy balance regulation; and the importance of not just of what we eat and how we exercise, but also when (i.e., timing). These recent insights may help in the development of novel therapeutic preventative and treatment approaches in the fight against modern-day disease.

Emmanuel (Manos) Stamatakis *Sydney University, Australia*

Emmanuel Stamatakis is a Professor of physical activity, lifestyle, and population health at the University of Sydney. He completed a PhD on objectively assessed physical activity and clinical childhood obesity at the University of Bristol. Between 2003 and 2013 he was based at University College London where he led the development and implementation of physical activity measures in the Health Survey for England and other large-scale nationwide surveillance studies. Emmanuel's work has received numerous research awards and he has published over 220 peer papers in in leading epidemiology, exercise medicine, and medical journals including BMJ, Int J Epidemiol, JAMA Intern Med, Annals Intern Med, and J Am Coll Cardiology. He is the Deputy Editor of the British Journal of Sports Medicine responsible for the physical activity and epidemiology sections. In 2017 Emmanuel initiated and is currently leading the development of the Prospective Physical Activity, Sitting, and Sleep consortium (ProPASS). Emmanuel is the proud owner of two rescued Hungarian mongrels who are often his counsellors and lifestyle coaches.

Physical activity and sedentary behaviour change: Drowning in a sea of possibilities?

Changing day-to-day behaviour is difficult, especially when the social, economic, and physical environments actively discourage positive change. Over 30 years' worth of research has not been able to identify a single, universally applicable, solution to the problem of physical inactivity which costs millions of deaths and compromised lives every year.

Technology has a great influence on the population's way of life, including physical activity and sitting behaviours: it first amplifies the problem at a large scale through its sexy offerings (screen media, labour saving devices, etc); then it puts forward equally sexy gadgets to help those motivated enough to move more.

In this talk I will use epidemiological and intervention evidence to discuss the role of technology, healthcare systems, and physical activity guidelines in improving physical activity and sedentary behaviour across the population.

Symposium I

Wednesday, June 26

11:30 – 12:30, 0.8 Rome

Advancing collaborative activity monitor research using open-source tools

Chair: **Greg Welk** *Iowa State University, USA*

Greg Welk *Iowa State University, USA*

Protocols and available data in FLASH (Free Living Activity Study for Health)

Background and Aims: A major challenge in physical activity (PA) research is in reconciling differences between estimates provided by different devices and methods. The challenges can be attributed to changing technology as well as to how PA data are processed, scored and interpreted. To address, this gap, it is important to develop collaborative platforms that facilitate data sharing and collaboration. This session will provide an overview of the Free Living Activity Study for Health (FLASH) project, an open-access data repository designed to facilitate comparisons of different monitors and methods. Methods: FLASH is an ongoing, 24 hour monitoring project conducted through the Physical Activity and Health Promotion lab at Iowa State University. Participants (18-60 years old) wear 7 different activity monitors for a 24-h period (midnight to midnight) and then complete the Act24 online recall instrument to code their behaviors. Participants wear 2 monitors on each wrist (Actigraph / Geneactiv on left and Actigraph / Axivity on right) as well as an Actigraph on the right hip, an ActivPAL on the right thigh and a Sensewear on the right arm. The range of devices and positions enable comparisons between wrist and hip worn devices as well as comparisons of parallel indicators from different devices. The inclusion of ActivPAL provides indicators of posture and a criterion indicator of sedentary behavior while the Sensewear provides a robust estimate of energy expenditure. Results: The most unique feature of the FLASH project is the temporal matching of data from the Act24 (and direct observation methods) to provide detail on the context of PA. The value of triangulating outcomes is well documented, but it has proven challenging to temporally link data at resolutions needed to understand and interpret error in monitor-based measures. The value of the FLASH dataset is that it provides linked indicators of each individual's sleep, sedentary and PA behaviors during the same 24 hour period. The processing and export features of the Act24 database enable data to be examined by day or activity, but a novel R-based extraction method provides a further level of integration by temporally linking monitor data at minute-by-minute resolutions. Temporally matched direct observation data are also available for a subsample of participants (~ 10%) that elect to be videotaped for a 30 minute free-living period. Conclusion: The utility of the integrated database system for 24 hour epidemiology applications will be highlighted by comparing estimates from the Act24 against temporally matched data from the SenseWear Armband and hip-worn ActiGraph data processed with the Sojourn method. Emphasis will be placed on how the contextual data from the Act24 provide additional perspectives when integrated with monitor-based data. However, the overall goal is to introduce the FLASH project as an open-access data repository to facilitate use by other researchers.

Paul Hibbing *University of Tennessee, Knoxville, USA*

Accessing and using data through the FLASH GitHub repository

BACKGROUND AND AIM: In sensor-based research, it is increasingly difficult for end-users to implement new methods. Thus, the most promising innovations tend to have little effect on common practice. At the same time, innovation is unnecessarily slow, due to a lack of collaboration in the sensor-based research community. Better sharing conventions would make the best methods more accessible for end-users, while also promoting more efficient innovation through collaboration. The aim of this talk is to highlight the usefulness of a few collaborative tools by using example data from the Free Living Activity Study for Health (FLASH), with special emphasis on features that serve both end-users and developers. METHODS: Publicizing a new method requires a streamlined system for sharing data and code, and there are several free and open source platforms for doing so. However, such tools are underutilized in the sensor-based research community. This talk will emphasize several tools, with the focal point being the online FLASH repository (https://github.com/PAHPLabResearch/FLASH), which is a publicly-available resource having usability that can be extended through R (https://www.r-project.org/), RStudio (https://www.rstudio.com/), and Git (https://git-scm.com/). RESULTS: The FLASH repository will house all raw data for public access, allowing third parties to explore their own questions with existing data. Additionally, the FLASH repository will contain various aggregated data sets, in which data from multiple sources have been individually processed and merged. Crucially, the FLASH repository also provides access to the code used to create the aggregated data sets, giving intermediate users a template they can tweak to customize their own data sets. The FLASH repository is connected to extensive version control, making it easy to track changes over time, and to experiment with new features. Furthermore, the online host for the repository (i.e., GitHub) is used widely for public projects, and provides convenient collaboration features where anyone can point out flaws in the code, request new features, add new materials, or get help with an issue. CONCLUSIONS: The tools presented in this talk can help to bridge the gap between end-users (for whom new sensor methods can be confusing) and developers (for whom it is second nature to develop new methods). The talk will aim to make end-users more comfortable with such powerful tools, while also providing developers with a framework for using the tools to their full potential. Ultimately, the demonstration will show how members of the sensor-based research community can better serve one another to promote faster progress.

Charles Matthews *US NIH/NCI, USA*

Application of a previous-day recall in monitor calibration and validation protocols and available data in FLASH (Free Living Activity Study for Health)

A major challenge in population-based physical activity research is gathering a more detailed understanding of the type, intensity, and domain/context of activities. Short-term recall methods, such as physical activity diaries and interviewer-administered previous-day recalls have been useful, but they are rarely used in large-scale epidemiological studies due to the cost and complexity of coding data or conducting telephone interviews. The Activities Completed over Time in 24 Hours (ACT24) System was designed to overcome these limitations as an automated self-administered previous-day recall of sleep, physical activity, and sedentary time. Validation studies have shown ACT24 estimates to be accurate at the population level and the tool is capable of rank ordering individuals in the population well (e.g., r >= 0.60). The system is composed of a Researcher Site that study teams use to register their studies and a Participant Site that is used to enter the recall data. A unique feature of ACT24 is its ability to capture of detailed information about 20-30 major activities reported on an average day that can be summarized in greater details by type (sleep, sedentary, physical activity), intensity (light, moderate, vigorous), and domain/context (personal care, household, occupation, transportation, leisure-time) providing richer detail about daily human activities. This type of information could provide insight into the breadth of activities that should populate future monitor calibration efforts and potentially an additional validation tool that provides much needed contextual detail. The ACT24 system is employed in FLASH as a method to provide an additional criterion measure and an indicator of behavioral context. The goal of this presentation is to introduce potential FLASH users to the ACT24 system and to discuss its strengths and weaknesses for its application in the FLASH study.

Symposium II

Wednesday, June 26

11:30 – 12:30, 0.9 Athens

Challenges and promise of quantifying free-living walking in neurological patients

Chair: **Fay Horak** *Oregon Health & Science University, USA*

Fay Horak *Oregon Health & Science University, USA*

Monitoring quality of mobility during daily life in people with neurological disease

BACKGROUND: Clinical practice would benefit from valid, sensitive, reliable measures of quality of walking in community settings that reflects disease type, severity and responsiveness to intervention. METHODS: We will summarize results of several studies on over 50 people with Parkinson's disease (PD), 20 people with multiple sclerosis (MS) and 100 control subjects who have worn inertial measurement units on their feet (SmartSox by APDM) and an Opal IMU on their lumbar spine for 7 days. We have over 20,000 hours of data collection with usable data for at least 5 days in 90% of subjects. Subjects wore the sensors an average of 60 hours per week, recording approximately 60 walking bouts per hour and 94 turns per hour. RESULTS: Most walking bouts are short in daily life. Over half the walking bouts in the community were less than 30 seconds in all groups. Longer walking bouts were associated with faster gait speed, longer stride length and larger angle of the foot a heel strike in the control group, but less so in the PD or MS groups, such that differences between groups were larger for longer walking bouts. Larger differences are found for quality than quantity of gait. Surprisingly, quantity of mobility, measured as the number and length of walking bouts and the number of strides and turns per hour did not differ between the people with PD and age-matched controls. In contrast, the people with MS did show fewer and shorter walking bouts and fewer turns per hour than the controls. People with MS were less active than people with PD or controls. Although gait speed was the same among the PD, MS and control groups, several gait measures were statistically different between groups: stance duration, variability of turn duration, and variability of trunk coronal displacement. Daily life gait may be more sensitive than a prescribed walk to neurological disease. Differences in gait and turning quality between groups were larger for the daily life monitoring than for a prescribed 2-minute walk test, especially for people with PD. For example, gait speed, gait speed variability and turning velocity were significantly different between PD and control groups for daily life monitoring but not for the prescribed walk because subjects with PD, but not controls, walked slower during daily life. Abnormalities in specific gait metrics provide a fingerprint for neurological diseases. Out of over 100 metrics calculated, the most sensitive gait and turning measures to PD was turn angle and coefficient of variation of pitch of the foot at heel strike with an area under the curve of .89. The metric best related to severity of PD, bradykinesia, balance confidence and balance performance was the turn angle per step, reflecting the many small steps used to turn by people with PD. CONCLUSION: Although of great promise, many questions need to be addressed before measures of gait quality during daily life can be useful as digital biomarkers of neurological health.

Silvia Del Din *Newcastle University, UK*

Measuring gait in Parkinson's disease outside the laboratory with wearable sensors: Advantages and challenges

Gait is emerging as a powerful tool to detect early risk and monitor disease progression across a number of diseases (e.g. Parkinson's disease (PD)). Typically quantitative gait assessment has been limited to specialised laboratory facilities. However, measuring PD gait in home and community settings may provide a more accurate reflection of gait performance as it allows walking activity to be captured over time in habitual contexts. Modern accelerometer-based wearable technology allow objective measurement of free-living walking activity/behaviour (macro level) as well as discrete gait characteristics (micro level). Quantification of PD macro and micro gait characteristics in unsupervised environments presents considerable challenges. This presentation will address the feasibility, methodological advantages and challenges of measuring macro and micro digital gait characteristics during free-living activity. The use of digital gait outcomes as a measurement tool for discriminating pathology (people with PD vs. healthy controls) and detecting risk (e.g. prodromal PD, fall risk) will also be discussed.

Jeff Hausdorff *Tel Aviv Sourasky Medical Center, Isreal*

Measuring gait outside the laboratory with wearable sensors: Understanding and leveraging the gap between lab-based assessments and 24/7 monitoring

The traditional evaluation of gait in the laboratory during structured testing has provided important insights, but is limited by its "snapshot" character and observation in an unnatural environment. Wearables enable continuous monitoring of gait and physical activity in real-world environments over an extended period of time (e.g., a week). Previous findings show that in-lab and real-world measures differ, however, it is not clear why. This presentation will describe these gaps in several different cohorts and illustrate how metrics based on wearables may outperform the conventional gait assessment. We illustrate this in studies among people with Parkinson's disease, people with mild cognitive impairment, people with multiple sclerosis, and elderly fallers. In addition, as a step towards better understanding these gaps, we describe the results of a direct comparison of in-lab usual-walking and in-lab dual-task walking to daily-living measures of gait. We find that typical gait values (subject-specific median) based on 24/7 monitoring are similar to in-lab dual-task walking values and significantly worse than in-lab usual-walking values. Moreover, tests of reliability show that in-lab values do not reliably reflect daily-walking values. We discuss the reasons for this gap and why 24/7 monitoring apparently offers a complementary approach to the more conventional one-time assessment of gait.

Symposium III

Wednesday, June 26

11:30 – 12:30, Auditorium 2

Novel methods for processing large activPAL device datasets. A review of different approaches to the challenge of effective data extraction.

Chair: **Allen Donnelly** *University of Limerick, Ireland*

Annemarie Koster *Maastricht University, Netherlands*

ActivPAL data processing in the Maastricht Study

BACKGROUND AND AIM: The Maastricht Study is a large population-based study regarding the etiology, pathophysiology, complications and comorbidities of type 2 diabetes. Currently extensive phenotyping data have been collected in over 8000 participants (approximately 25% has type 2 diabetes), aged 40-75 years. Daily activity levels were measured using the activPAL3 physical activity monitor. We aimed to develop a tool to process and create a wide range of activity and sedentary variable from activPAL data. METHODS: Using a waterproofed attachment, all participants were asked to wear the accelerometer for 8 consecutive days, without removing it at any time. Data were uploaded using the activPAL software and processed using customized software written in MATLAB (https://www.demaastrichtstudie.nl/accelerometry). The software includes an algorithm to automatically determine wake and bed times on an individual level on multiple days. The algorithm is based on the number and duration of sedentary periods to identify bed times, and on the number and duration of active periods (standing or stepping) to identify wake times. RESULTS: The algorithm showed high accuracy in determining waking time compared with self-report, as the intra-class correlation coefficient (ICC) was 0.79 (p<0.001) and the mean difference in waking time between both methods was 0.02 h (1.2 min), with limits of agreement of −1.1 to 1.2 h. The customized software further calculates a wide range of sedentary and activity variables during waking time including the time spent sitting or lying; standing; and stepping and variables on posture transition; number bouts of activity; and bout duration. Physical activity (stepping) was further classified into intensity categories based on step frequency. All activity variables were calculated hourly and for every day separately, weekday and weekend days. CONCLUSIONS: Our software provides and accurate method to identify walking time in 24-h activPAL data and can be used to process and analyze activPAL data in large population-based studies.

Charlotte Edwardson *University of Leicester, UK*

A java application for processing activPAL data: Processing PAL

Background: The activPAL device, worn on the thigh, can accurately assess sitting/lying, standing and stepping behaviours as well as transitions from a seated to upright posture and vice versa. This data can be collected over a 24 hour period for numerous days. A challenge for researchers is to isolate valid waking wear data from sleep and non-wear as well as determining valid wear days. We developed a simple automated algorithm to classify activity bouts recorded in activPAL 'Events' files as 'sleep'/non-wear or not and to classify a day as valid or not. This was designed for use with 24 h wear protocols in adult populations. The algorithm was originally written in two software packages (STATA and SAS) and users needed a basic understanding of code in order to use the algorithm as well as access to these packages or the skills to translate this code into a package they were familiar with. Method: Acknowledging this as a barrier for researchers, we have recently designed and released a user friendly, freely available, application in Java (named Processing PAL) which enables users, with a few tick box selections, to apply the aforementioned automated algorithm to their activPAL 'Events' files, visualize and check the data and create outputs describing sitting and physical activity behaviour. Results and Conclusion: In this presentation, the process for using Processing PAL will be described by outlining: 1) the automated algorithm approach and the strengths and limitations of the algorithm, 2) the visualization of data and how it can be used to view behavioural patterns within a day and across days but also to visually gauge the algorithm's performance to decide whether the algorithm rules need adapting, 3) the option of performing corrections to the data with reference to self-reported sleep/wake times, and 4) the range of output variables available.

Kate Lydon *KAL Research & Consulting, UK*

Processing 24-hour accelerometry data in the R language and statistical environment

Wearable accelerometers are now capable of capturing an unprecedented amount of high frequency data for days to weeks at a time. As such, their use in health research is proliferating and researchers have an increasing opportunity to uncover a diverse set of health-predictors and outcomes from these data. However, advances in hardware capabilities have not been matched by software and data processing tools. Manufacturers often provide software to process and summarize device-specific datasets, but as the application of wearable accelerometers continues to diversify, it is increasingly challenging to develop software tools that are scalable to all study populations and research questions. Faced with unmet needs, researchers have begun to develop their own data processing methodologies for extracting information from accelerometry datasets. This presentation will largely focus on the activpalProcessing package published in the R language and statistical computing environment. The package processes 24-hour activPAL data and allows self-report diaries of sleep and non-wear time to be used to clean the data before processing. We will provide a brief tutorial on this package and discuss its strengths and limitations. We will also highlight several other packages published in R that allow researchers to extract more detailed information from accelerometry data than traditionally possible. These tools include unique data visualizations tools, data integration tools that allow accelerometry data to be synchronized with other data sources such as physiologic or self-report data and flexible data cleaning tools that allow accelerometry data to be filtered in researcher specified terms.

Kieran Dowd *Athlone Institute of Technology, Ireland*

The analysis of sedentary patterns and physical activity behaviours using the activPAL

Epidemiological studies have highlighted the deleterious effects of the total volume and accumulation of sedentary time on health indices. However, most of such studies have employed methodologies that do not directly measure the sedentary state. Technological developments in the area of motion sensors have enabled the accurate identification of postural position and have provided researchers with an alternative to relying on self-reported sedentary time or sedentary time from count-to-activity thresholds. The activPAL is currently the most widely utilized device for the examination of such behaviors, primarily due to the high level of accuracy in postural identification. The activPAL provides an output which can be interpreted without the need for further processing. However, for more detailed analysis and interpretation of activPAL data, clear methods for data processing are required. This presentation will provide a detailed description of the methodologies that we have developed and employed in our research, which quantify a range of relevant variables for researchers in activity behaviors and health. These variables include estimates of waking periods, sitting time, patterns of sitting time and standing time. Our methods couple this with estimates of time spent in each physical activity intensity band by processing the data using acceleration thresholds. These thresholds are generated from validation studies where energy expenditure is measured using expired gas analysis. This combined approach allows 24-hour measurement of time spent in physical behavior domains such as sleep, standing and sitting in addition to estimates of time spent in light and moderate-to-vigorous activity. It should be noted that the activPAL device offers the potential of distinguishing standing time from light activity, resulting in a measure of light activity that relates to movement and not posture. This analysis was originally completed with Matlab and LabView program, but the methods have recently been further developed to create a free to use R program. The methodology derives a substantial data set from each 7-day activPAL recording, including detailed information on the pattern of sedentary bout duration. All such automated methods have limitations. These include difficulties in identifying sleep in those with unusual sleeping behaviors, the analysis of data in 24-hour blocks and the effective detection of non-wear time. The implications of these issues, how they can be avoided in processing and alternative approaches will also be discussed during this presentation. The advantages of this approach are the wide range of objectively determined and objectively processed activity variables, including total time spent sitting/lying, standing and stepping, number and duration of daily sedentary bouts and both bed hours and non-bed hours, which may be of interest when examining association between physical activity, sedentary behaviors and health.

Symposium IV

Friday, June 28

12:30 – 13:30, Auditorium 2

Doubts About Bouts: Time in bouts of MVPA fails to characterise patterns of physical activity

Chair: **Joss Langford** *Activeinsights, UK*

Melvyn Hillsdon *Exeter University, UK*

Characterising individual bouts of physical activity: The consequences of processing decisions

These physical activity events or bouts can be characterised in terms of frequency, duration, intensity, type, volume and pattern. Accelerometers are now widely used to collect movement data in many studies. However, accelerometer data is only a surrogate measure for physical activity. Therefore, in order to characterise physical activity behaviour the accelerometer data needs conversion to appropriate metrics. Traditional methods for doing this may have led to premature conclusions about the value of the duration of physical activity and the misclassification of the prevalence of physical activity in people in differing disease states. Further, traditional methods have failed to develop our understanding of the relative contribution of the different characteristics of physical activity events. This is important as specific characteristics are known to have differential effects on different health outcomes.

In this presentation traditional and novel metrics will be presented that characterise the duration, intensity and volume of individual events. The effect of different processing methods on each of the metrics will be compared and contrasted along with the implications for future research.

Joshua Twaites *University of Exeter, UK*

Data dependent identification and characterisation of physical activity bouts

BACKGROUND AND AIM: Current approaches to physical activity bout recognition make use of expert knowledge and calibration studies to find fixed values to determine if a bout is occurring. This use of fixed values limits the ability of such methods to generalise to differing populations - that may have different acceleration characteristics. The majority of research uses these bouts to derive the amount of time spent per day/week above a single intensity threshold (MVPA). This aggregation into a single metric results in considerable data loss, and doesn't allow for investigation into how certain characteristics of physical activity may be associated with health and performance outcomes. This work suggests a methodology that allows for the leveraging of expert knowledge while allowing for the ability to generalise to differing populations. In addition, suggesting a number of metrics that may be used to characterise physical activity bouts by their duration, intensity and volume. These additional metrics allow for both a deeper understanding of how physical activity may be structured and how this structure may impact health outcomes. Furthermore this work discusses metrics that characterise the pattern in which physical activity is gathered (both within and between day). METHODS: Adaptive thresholds can be created by making use of state of the art cluster analysis techniques, allowing for initialisation of the thresholds with expert determined values, while allowing them to adapt to the participants specific data. These adaptive threshold derived bouts were compared to bouts identified from population specific, fixed value thresholds (as derived by calibration studies). After the identification of bouts, metrics characterising their duration, intensity and volume were computed, as well as metrics that describe the pattern in which the physical activity was gathered. The associations of these metrics with a variety of health outcomes was computed and compared to simple aggregate measures. RESULTS: The cluster analysis based technique allows for physical activity bout recognition results that are comparable to population specific fixed value thresholds, ICC = 0.65-0.97. Metrics that describe the duration, intensity and volume are all highly correlated with a variety of health outcomes, r = 0.21-0.65, outperforming single aggregate values. Metrics characterising the pattern in which the physical activity is gathered are highly correlated with health outcomes, r = 0.34-0.67, outperforming all aggregate measures. CONCLUSIONS: It is possible to use a cluster analysis based technique to identify physical activity bouts with recognition rates equivalent to calibration derived fixed value approaches. In addition, metrics that characterise the duration, intensity, volume and pattern of physical activity bouts can outperform simple aggregative measures for a variety of health outcomes.

Brad Metcalf *Exeter University, UK*

Physical activity pattern metrics improve the association between physical activity and fitness in Heart Failure patients

Aim: To determine whether novel metrics of how physical activity (PA) is accumulated, not just how much, improves the association between PA and fitness in heart failure (HF) patients.

Methods: Baseline data from n=187 HF patients that were recruited for the REACH-HF intervention study were used for analyses. Fitness was measured by an incremental shuttle walk test and PA was measured with 7day accelerometry (GENEActiv, Activinsights, UK). The following PA metrics were computed: 'All MVPA', 'MVPA in ≥10min bouts', 'MVPA in <10min bouts', 'between day variation in all MVPA' and 'within day (between consecutive hours) variation in all MVPA'. Hierarchical multiple regression was used to determine whether PA pattern metrics were associated with fitness independently of one another.

Results: A model only containing 'All MVPA' as the predictor explained 23.4% of the variation in fitness (R2Adj=0.234, p<0.001). This increased to 31.0% when 'All MVPA' was replaced by 'MVPA in ≥10min bouts' (betastd=0.47, p<0.001) and 'MVPA in <10min bouts' (betastd=0.16, p=0.021) in the model simultaneously. Adding 'between day variation in MVPA' (betastd=0.18, p=0.003) and 'within day variation in MVPA' (betastd= -0.13, p=0.069) increased the explained variance to 34.5% (R2Adj=0.345, p<0.001).

Conclusion: Longer bouts of MVPA were more strongly associated with fitness than shorter bouts, for a given amount of MVPA. Greater variability between days and lower variability within days were more strongly associated with fitness. Knowing how MVPA is accumulated, not just how much, is important regarding fitness in HF patients and could also be important for other health measures.

Alex Rowlands *University of Leicester, UK*

Meaningful, interpretable, standardised accelerometer metrics for global surveillance and building an evidence-base for physical activity guidelines

BACKGROUND AND AIM: Accelerometer data, analysed with cut-points, are frequently evaluated relative to physical activity guidelines developed from self-report data; this is inappropriate as the two measures are conceptually different. Accelerometer-driven guidelines are not available, likely due to the lack of consensus on meaningful and interpretable accelerometer outcomes. This presentation will describe standardised population-independent data-driven accelerometer metrics that can be easily applied to very large datasets. METHODS: The metrics fall into two categories: 1) whole day, and 2) most active X min of the day. 1) The average acceleration and intensity gradient describe the volume and intensity distribution of physical activity over the 24 h day, respectively. They are not highly correlated, thus can be used in regression analyses to determine independent, additive and interactive effects of physical activity on health. For example, we recently found that: for children, intensity distribution was associated with adiposity independent of volume of physical activity; for adults, the effects were stronger and additive; for bone health, associations were strongest if intensity was high, largely irrespective of volume of physical activity. 2) The minimum acceleration value above which a person's most active minutes (e.g. 30 min (M30_{ACC})) is accumulated. Unlike cut-points, MX_{ACC} metrics are continuous variables with no person scoring zero, regardless of activity intensity. RESULTS: Clear examples will be presented to demonstrate how these accelerometer metrics avoid the pitfalls of cut-point analyses and could be used to facilitate global surveillance and development of evidence-based physical activity guidelines directly from accelerometer data. CONCLUSIONS: As data accumulates, physical activity of groups and individuals could be interpreted relative to age- and sex- specific norms and/or relative to values associated with health. This is akin to the interpretation of other measures that are not intuitively understandable, yet with regular use their values have become meaningful, e.g. body mass index and blood pressure.

Symposium V

Friday, June 28

12:30 – 13:30, 0.8 Rome

Both the day and night matter: Application of wrist, chest and thigh worn accelerometers to identify 24-hour activity patterns

Chair: **Sari Stenholm** *University of Turku, Finland*

Tuomo Nieminen *National Institute for Health and Welfare, Finland*

Sleep detection in free-living 24-hour accelerometer data with unsupervised machine learning

BACKGROUND AND AIM In the FinHealth 2017 Survey, a population-based health-examination study, 940 participants aged 25 to 93 years (44% men) wore a triaxial accelerometer (Actigraph GT9X Link) on their non-dominant wrist for 7 days. Participants also kept a diary over their bedtimes. The raw data forms a three dimensional time series indexed at 100 Hz. In previous analyses, we have used Actigraph's proprietary vector magnitude counts to explore the 24-hour variation in activity. Focusing on the raw data will include the identification of different movement behaviors, including sleep. Sleep is an important component of the full movement continuum, and identifying periods of sleep in free-living data will be important for further studying wake time behaviors. Here, we describe our approach for processing raw 24-hour wrist-accelerometer data and utilizing unsupervised machine learning methods for detecting periods of sleep. METHODS To access the data efficiently and with full control, we wrote an R package to read binary data from Actigraph GT9X monitors. It is impractical to work directly with the raw accelerometer data, and it is common practice to aggregate the data to non-overlapping intervals of identical duration (epochs). The appropriate choice of epochs and aggregation functions depends on the problem being solved. We use epochs between 10-60 seconds and summary functions of the vector magnitude (VM) to describe activity. To account for the human sleep-wakefulness cycle, we transform time since midnight into cyclic time using sin and cosine transformations. Summaries of VM and cyclic time define an aggregated time series which describes the 24 hour periods of individuals. Assuming no known labels in the data, sleep detection from this data is an unsupervised machine learning problem. We assign non-overlapping segments of the series into one of two possible categories (sleep and awake) by utilizing time series segmentation methods (e.g. the Hidden Markov Model). RESULTS We compare the effects of using different summaries of VM as our feature set for sleep detection, and we compare the segmented individual time series to the results from participants' sleep diaries to assess the goodness of the segmentation. CONCLUSIONS Data collected by accelerometers over 24 hours from free-living situations present challenges in processing, feature extraction and modeling. Working directly with raw data using open software will allow comparison between studies and opens discussion on best practices and methods. This will help researchers to fully benefit from the rich time-series data collected over several consecutive days and nights.

Anna Pulakka *University of Turku, Finland*

24-hour activity patterns in aging workers measured by wrist and thigh-worn accelerometers

BACKGROUND AND AIM: Measuring movement behaviors over the 24-hour period provides a comprehensive view to sleep, sedentary behavior (SB) and physical activity which are all associated with health. However, different accelerometer placements and analysis methods may influence the activity estimates. Here we aim to describe 24-h physical activity patterns during different days before and after retirement derived both from wrist and thigh worn accelerometers. METHODS: Data were from the Finnish Retirement and Aging Study (FIREA), a longitudinal cohort study of ageing workers. Participants (mean age 62.7 years, SD 1.0, 86% women) wore an ActiGraph accelerometer on their non-dominant wrist for one week before and after retirement (n=368), with one year between the measurements. A sub-sample (n=180) also wore simultaneously an Axivity accelerometer on the medial front of the right thigh for minimum of one working day and one day off (cross-sectional data before retirement). Data from the wrist and thigh accelerometers were analyzed with package GGIR in R software and a customized MATLAB program Acti4, respectively. Sleep was defined by a combination of sleep diary and the GGIR algorithm for the wrist accelerometers and by a sleep diary only for the thigh accelerometers. RESULTS: Before retirement, the mean (SD) time in sleep, SB, light physical activity (LPA) and moderate-to-vigorous physical activity (MVPA) from the wrist accelerometer were 474 (54) min, 624 (120) min, 268 (102) min, and 56 (38) min, respectively. The corresponding figures from the thigh accelerometer were: sleep 481 (SD 41) min, SB (sitting) 549 (104) min, LPA (standing, moving and walking slow) 303 (88) min, and MVPA (walking fast, running, climbing stairs, cycling and rowing) 81 (27) min. Based on both methods, participants slept less, were more sedentary, and had more LPA and MVPA during working days than days off. For the longitudinal data, we plotted mean counts per minute from the wrist accelerometer against the hour of the day. As can be seen from Figure 1, activity patterns between working days and days off before retirement were very different while activity patterns after retirement resembled closely to the patterns during days off. Manual workers had generally higher activity during working days, but there were no differences in activity patterns between manual and non-manual workers during days off or days after retirement. CONCLUSION: In conclusion, accelerometer placement and methods for analyzing 24-hour data have a large impact on the activity outcomes. Work influences activity patterns, and the removal of work leads to similar activity patterns after retirement as seen during days off before retirement.

Timo Rantalainen *University of Jyväskylä, Finland*

Seasonal variation in circadian activity patterns among adults aged 75+ in the AGNES cohort study

BACKGROUND AND AIM: Seasonal variation is evident in circadian activity patterns. The effect is more pronounced farther from the equator and is presumably caused by a combination of prevalent weather and ambient light. The literature seems to suggest that older individuals are less susceptible to these seasonal changes in physical behaviour while at the same time those with compromised physical ability may be more affected by inclement weather than their more able peers. However, the effects of physical ability and advanced age on seasonal variation in circadian activity pattern has been sparingly explored. Therefore, the purpose of the present study was to examine the effect of season on physical activity patterns based on continuous 7-day concurrent chest- and thigh-worn actigraphy among older adults. METHODS: 215 women (age = 78.4 (SD 3.7)) and 143 men (age = 78.2 (3.8)) participated. Activity behaviour was evaluated based on posture determined from the sensor orientations. Sitting and lying postures were classified as sedentary behaviour, and all other postures as active behaviour. Additionally, the thigh-sensor resultant acceleration was divided into non-overlapping one minute epochs (Figure 1) for circadian activity pattern evaluation using extended (5-parameter) cosinor analysis. Physical ability was dichotomised based on a short physical performance battery (SPPB) test (<10 less able). Finally, the dataset was divided into four season groups based on the measurement dates. RESULTS: Significant behaviour x season, and behaviour x ability interactions (p = 0.014 to 0.038) were observed, whereas no behaviour x ability x season interaction was indicated (p = 0.30). The winter group was 48 to 57 min/day more sedentary compared to the autumn and spring groups, respectively (p < 0.015). The individuals with lower SPPB had 36 min/day more sedentary behaviour than the ones with higher SPPB (p < 0.017). In cosinor analysis the width ratio differed between season groups (p = 0.001), goodness of fit differed between physical ability groups (p = 0.001), and a season x ability group interaction was observed in timing of the cycle peak i.e. acrophase (p = 0.044). Spring and summer groups had wider active phase width than the winter group (p < 0.041), the group with higher SPPB had better goodness of fit (p = 0.001), and the ones in lower SPPB group had an earlier acrophase in autumn group compared to the spring and the winter groups (p < 0.047), while no between season-groups difference was observed in higher SPPB group acrophase (p>0.077). CONCLUSIONS: We observed seasonal variation in circadian physical activity patterns but less evidence was found to perpetuate the hypothesis that physical ability might modify this seasonal variation. Targeting winter months with interventions that enable engagement in active behaviours should be considered when promoting and implementing policies to facilitate physically active life-styles among older individuals.

Symposium VI

Friday, June 28

12:30 – 13:30, 0.9 Athens

Beyond wearable sensing: Innovative approaches to measure physical behaviour in the management of chronic diseases

Chair: **Miriam Cabrita** *Roessingh Research and Development, Netherlands*

Miriam Cabrita *Roessingh Research and Development, Netherlands*

Why conventional research methods for measuring physical behaviour do not fit the management of chronic diseases? Past, present and glimpse at the future…

Adopting an active lifestyle is one of the key factors in the prevention and self-management of most chronic diseases. Interventions targeting promotion of physical activity are often limited to a short period of time, with monitoring periods no longer than a couple of weeks. Literature shows that sustaining an active lifestyle remains a challenge, with people often going back to old habits after some months. Ideally, we would be able to continue monitoring the physical behaviour far beyond the end of the intervention, during months or even years. Only in this way, we would be able to detect subtle changes in behaviour, predicting relapses and intervening whenever necessary. While high measurement accuracy is likely to be one of the key requirements in studies in the lab environment and short daily life studies, when monitoring physical behaviour for longer periods, requirements as wearability of the sensor, looks and easy-of-use must be prioritized with the best interests of the user in mind. Add the fact that, when doing research on prevention or self-management of chronic diseases, we are often interested in the interaction between physical behaviour and other parameters - such as other lifestyle components, symptoms and mental health indicators - resulting in a complexity of devices. Furthermore, interventions targeting prevention and self-management of chronic diseases often include a coaching feature, delivered through ICT, as a smartphone application or website. The possibility of providing real-time feedback is in such cases of high importance. This presentation introduces the topic of the symposium. We start by providing a brief overview of the evolution of the methods to assess physical behaviour, looking at research-oriented devices and consumer targeted devices. Taking a critical view, we will look at the advantages and drawbacks of the different types of devices. Furthermore, we will formulate key questions that a research team should pose before choosing the sensing method, prioritizing the interests of the research participant. Finally, we will provide a glimpse at innovative ways to assess physical behavior, making the bridge to the following presentations.

Japp van der Waerden *Eindhoven University of Technology, Netherlands*

Future-proof? The longitudinal multi-method data collection of SOULMATE and its future integration into smart cities

The rise of GPS technology over the past two decades has opened up a world of possibilities for travelers, and for the researchers who study them. GPS trackers allow us to monitor exactly where a person is at any given time; to see where a person travels and estimate how that person is moving as well. However, GPS data by itself is not always enough to answer the questions that are of interest to important challenges of today, such as supporting an active healthy lifestyle of the growing aging population. Personal and environmental factors can play a large role with regards to physical activity, which needs to be measured somehow as well, and preferably at multiple moments. Thankfully, most people carry these small devices around that enable the integration of different kinds of measurements; called smartphones. The SOULMATE project aims to use an integrated multi-method longitudinal approach to measure the effectiveness of its mobile application. Through training, routing and safety interventions, the SOULMATE app aims to make travel more accessible and safe for seniors. Combinations of these aspects should help overcome most of the diverse challenges that this group faces, ultimately stimulating active lifestyles and improve overall quality of life. One of the main pillars of the SOULMATE project is the inclusion of end-users in its development. Therefore, a longitudinal measurement period (field trials) will be included that should provide insight into the actual outcomes of using the application in daily life. As a part of these field trials a select group of motivated end-users will be followed for a six-month period. During this period, users will share their travel behavior through GPS tracking. In addition, these measurements will be supplemented with a variety of potential outcome scales such as overall quality of life, social networks, loneliness, and self-reported health. The mobile phones application allows for easy and flexible gathering of the outcome measures. For instance, short questions can be asked of participants when they arrive at their travel destination, or when they are shown to be idle for a long period. At the same time, data from the built environment is becoming more readily available as well. More and more Smart Cities pop up across the horizon, using ICT to dynamically inform decision-making. From the perspective of SOULMATE, many of these developments can be of great value to the promotion of an active and healthy lifestyle. For instance, real-time integration of air quality or traffic sensors can help people steer clear from polluted and busy areas. Or, smart street lighting can direct pedestrians to their destinations in an intuitive way. Potentially, different users of mobility solutions can join up to travel together in a social and safe way. While most of these examples are still in development, we can already think about and discuss the many possibilities and get ready for the Smart future!

Kostas Konsolakis *University of Twente, Netherlands*

Smartphone-as-a-Sensor: What can the data collected by the smartphone tell us about our physical behaviour?

Human behaviour understanding has become one of the most promising research areas in healthcare. In particular, the research on physical activity recognition has gained much attention during the recent years as an essential descriptor of human behaviour. The latest technological advances have enabled the release of smartphone devices with powerful specifications and enormous sensing possibilities. Smartphones have been used in activity recognition systems, as a technical follow-up of traditional accelerometer-based mechanisms, focusing on collecting data continuously and unobtrusively. This talk will emphasise on distinguishing physical behaviour over different periods of time and presenting the concept of physical primitives and routines. Physical primitives represent short-term physical behaviours and can range from minutes to hours (e.g., the performed activities every minute, the number of counting steps every hour, etc.). On the other hand, physical routines are long-term physical behaviours that represent more meaningful and time lasting activities that can be used to derive information about a user's lifestyle. The period of time for the routines can range from days, weeks, months or even years. Based on the number of steps and/or the number of the performed activities, that entail energy expenditure over a certain period of time, physical routines can be categorised as sedentary, lightly active, moderately active or vigorously active. Furthermore, physical routines can be further examined to detect trends or patterns that restrain users from following a normative or healthy lifestyle. For instance, monitoring long-term behaviour could reveal information about a set of patterns that can help to distinguish a 'working lifestyle' from a 'lifestyle after retirement' (modelling between-persons variations), but could also characterise subjective behavioural patterns that force individuals to have a sedentary lifestyle on specific weekdays (modelling within-persons variations). Consequently, smartphone physical behaviour monitoring through primitives and routines can be used to detect behaviour changes for a given user or group of users and play a major role in promoting active and healthy ageing.

Harm op den Akker *Roessingh Research and Development, Netherlands*

Coach-as-a-Sensor: Embodied conversational agents as a tool to collect physical behavior information

Although the possibilities for automatic and unobtrusive measuring of physical behaviour in daily life situations have increased dramatically over the past years, there are simply fundamental limits to the quality and detail of information that can be measured using digital sensors. Although intelligent, personalized methods (e.g. machine learning) may be used to augment the capacities of digital sensors, mistakes - such as confusing walking with a stroller with cycling - may never be fully avoided.

Furthermore, state of the art coaching applications are moving away from targeting singular domains, such as physical activity coaching, moving towards more holistic approaches to healthy behaviour change. As such, these coaching applications require a deeper understanding of the user's behaviour - information that is also difficult to obtain from digital sensors alone.

A solution to the problem of obtaining detailed and multi-domain behaviour information may present itself as a by-product of another shift in state-of-the-art coaching applications - the shift towards more intuitive, natural language interfaces. Coaching towards healthy behaviour by means of eHealth has proven to be difficult, partly due to the disconnect between technology and the target audience (often older adults), and partly due to the complexity of capturing quality coaching advice using simple digital apps. By using embodied conversational agents - virtual humans that talk, behave and emote just like human coaches - the field is aiming to solve this HCI-related problem.

In the European funded Council of Coaches project, a group of virtual embodied coaches is being developed to coach older adult end-users towards a healthy lifestyle. In this virtual coaching application, a "traditional" sensing framework, using e.g. inertial sensors to capture the daily movement of its users, is being augmented by the Coach-as-a-Sensor paradigm. Through natural language dialogue, the virtual coaches can steer the conversation with the end-users in such a way as to verify measured data, and fill in the gaps, where sensor data is unable to provide the required detail needed for coaching the user.

INVITED SPEAKERS ABSTRACTS

THURSDAY, JUNE 27, 2019

09:30 – 10:00

Martijn Spruit *CIRO*

0.8 Rome

The complexity of physical inactivity in patients with COPD

Andreas Holtermann *University of Southern Denmark*

0.9 Athens

How measure physical activity at work – different from during leisure?

Adult populations spend about half of their waking hours at work. The health benefits of leisure time moderate-to-vigorous PA (MVPA) are evident. In contrast, occupational MVPA increases risk for sick leave, early retirement and mortality – with enormous costs for companies and society.

Accordingly, public health research has traditionally focused on promoting leisure time MVPA, while occupational health research has mainly aimed to reduce occupational MVPA.

Proper measurements of PA at work and leisure are required for understanding this PA paradox, for promoting health for particularly low-educated workers, and reducing huge societal costs of poor health, sickness absence and early retirement.

Anisoara Ionescu *Ecole Polytechnique Federale De Lausanne, Switzerland*

Auditorium 2

Assessing complexity in physical behaviour: what does it tell us?

The 'complexity' concept postulates that healthy status is characterized by ability to responds to environmental demands reflected in a higher diversity and dynamics of body movements and activities. On the other side, advanced aging and/or disease status may be characterized by progressive movement impairment, difficulties with daily tasks, i.e., a less complex physical behavior. This presentation will address the main theoretical and practical considerations necessary for definition of complexity of physical behavior as a comprehensive outcome measure: (1) definition of temporal physical activity patterns; (2) analytical tools for complexity assessment; (3) clinical appraisal and current evidence; (4) perspectives and new research directions.

FRIDAY, JUNE 28, 2019

09:30 – 10:00

Sebastien Chastin *Glasgow Caledonian University, Scotland*

0.8 Rome

24 hours Movement Behaviour: Concepts, Analytics and futures

Current technology allows us to track movement behaviours through the 24-hour cycle including many of the attributes of the behaviours such as their intensity or social and geographical context. It is very likely that the advances in wearable and sensor technology will rapidly speed up and provide us with increasingly detailed both temporally and qualitatively. This will allow us to gain better understanding of the dynamics of human movement behaviour. However, there are a number of technical, conceptual and ethical challenges that need to be overcome. This talk will discuss some of the recent advances in analytical methods including sequence analysis, compositional analysis, analysis of patterns, behaviour classification and data harmonisation and point out their limitations. Future avenues and potential advances will be explored through a cornucopia of personal failure to deliver sensible solutions.

Sophie van Belle *Maastricht University, Maastrict*

0.9 Athens

Modeling 24h activity patterns using random effects zero-inflated beta-binomial models

Accelerometers permit to record physical activity type (e.g. stepping, standing, sedentary, sleeping) and intensity continuously over long time periods at high temporal frequency. This generates a huge amount of observations per subject. For example, recording information every second for 24 hours produces 86400 observations per subject. This poses a statistical challenge that can be handled differently depending on the study purpose. When the aim is to model 24h overall activity patterns and compare these patterns between several groups (e.g. males and females), the amount of data can be reduced by summarizing information over shorter time periods (e.g. one minute or even one hour). In Maastricht study, the number of seconds per hour under each physical activity was determined during one week in 7000 patients.

To model the daily pattern of this new bounded outcome, a random effects zero-inflated beta-binomial model offers several advantages. Zero-inflated models permit to decompose physical activity in two distinct processes and to model them individually. For each time period, one model describes the probability to perform a certain activity type. Then, for active subjects, a second model describes the activity intensity. Considering a beta-binomial model accounts for the bounded nature of the outcome and for correlation between observations within each time interval. The correlation between time intervals is then taken into account with random effects.

The daily activity patterns of males and females in Maastricht study will be compared with the proposed method that can be easily implemented in standard Bayesian software (e.g. Jags).

Vincent van Hees *Independent Consultant, Netherlands*

Auditorium 2

An open heuristic method that helped to gain new insights in human sleep

In this talk I will describe how I developed a heuristic algorithm for estimating sleep-wake patterns from wrist-worn raw data accelerometers. I will also show how this has recently contributed to new insights based on UK Biobank data into the human body clock and led to the identification of new links between our genes and sleep traits. Furthermore, I will stand still at the importance of making the sleep detection algorithm available as open source research software.

AUTHOR INDEX

Authors and Presenters

All authors (lead and additional) and presenters are listed here for easy cross-referencing to their respective abstract. The full list of abstracts is available as a download from the ICAMPAM website (*www.ismpb.org*).

Interpreting the presentation numbers:

The first section of the number represents the type of presentation as follows;

0 Oral presentation
1 Poster Session 1
2 Poster Session 2
3 Poster Session 3
4 Poster Session 4

The second section represents the session number for Oral presentations or the number on the poster board.

Poster themes are denoted by colours represented in the Poster Session Floor Plan on page 68

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ORAL SESSIONS

Oral Sessions 1 – 3

WEDNESDAY, JUNE 26
10:00 – 11:00

0.1 Multi-modal assessment

location: 0.8 Rome

0.1.1 Supporting physiotherapy in Parkinson's disease with a remote monitoring system focussed on falls and activity: the Vital@home study

Luc Evers[1], Ana Silva de Lima[1], Giulio Valenti[2], Luca Palmerini[3], Elif Eryilmaz[4], Stephen Prochnow[5], Jessica Hubbers[1], Salvatore Saporito[2], Lorenzo Chiari[3], Bastiaan Bloem[1], Heribert Baldus[2], Marjan Meinders[6]

[1]Radboud University Medical Center; Donders Institute for Brain, Cognition and Behaviour, [2]Philips Research, [3]University of Bologna, [4]Technische Universität Berlin, [5]Curamatik Unternehmergesellschaft (haftungsbeschränkt), [6]Radboud University Medical Center; Radboud Institute for Health Sciences

0.1.2 Combining accelerometry with GPS-triggered e-diaries to investigate physical activity and mood in adolescent's everyday life

Elena Koch[1], Heike Tost[2], Urs Braun[3], Gabriela Gan[2], Marco Giurgiu[1], Iris Reinhard[2], Alexander Zipf[2], Ulrich Ebner-Priemer[4], Markus Reichert[2]

[1]Karlsruhe Institute of Technology (KIT), [2]Heidelberg University, [3]Central Institute of Mental Health (CIMH), Medical Faculty Mannheim, Heidelberg University, [4]Department of Sports and Sports Science, Karlsruhe Institute of Technology (KIT)

0.1.3 Feasibility of a sensor based technological platform for inhospital rehabilitation patients

Maartje Hendriks[1], Jaap van Lotringen[1], Marije Vos-van der Hulst[1], Noël Keijsers[1]

[1]Sint Maartenskliniek

0.1.4 Improving physical behaviour monitoring by combining Accelerometry with GPS-location tracking to investigate mental health indicators and to inform real-life interventions

Markus Reichert[1], Heike Tost[1], Urs Braun[2], Alexander Zipf[1], Matthias Limberger[3], Andreas Meyer-Lindenberg[2], Ulrich Ebner-Priemer[4]

[1]Heidelberg University, [2]Central Institute of Mental Health (CIMH), Medical Faculty Mannheim, Heidelberg University, [3]Karlsruhe Institute of Technology (KIT), [4]Department of Sports and Sports Science, Karlsruhe Institute of Technology (KIT)

0.1.5 Spatial distribution of children's physical activity in New York City parks: Accelerometer and GPS assessed patterns in low-income and racial/ethnic diverse communities

Claudia Alberico[1], Myron Floyd[1], Oriol Marquet[2], Jing-Huei Huang[1], Elizabeth Mazak[1], J. Aaron Hipp[1]

[1]North Carolina State University, [2]Instituto de Salud Global de Barcelona

0.2 Research devices

location: 0.9 Athens

0.2.1 Associations between physical activity and sedentary behaviour accumulation patterns and weight status in children and adolescents: A latent profile approach

Simone Verswijveren[1], Karen Lamb[2], Rebecca Leech[3], Jo Salmon[3], Anna Timperio[3], Kelly Mackintosh[4], Melitta McNarry[4], Rohan Telford[5], Richard Telford[5], Nicola Ridgers[3]

[1]Deakin University, [2]Murdoch Children's Research Institute, [3]Institute for Physical Activity and Nutrition (IPAN), [4]Swansea University, [5]Centre for Research and Action in Public Health

0.2.2 Heart rate versus accelerometry based physical activity assessment in older adults

Laura Karavirta[1], Timo Rantalainen[1], Neil Cronin[1], Milla Saajanaho[1], Erja Portegijs[1], Taina Rantanen[1]

[1]University of Jyväskylä

0.2.3 Description of raw triaxial wrist accelerometer-measured physical activity in mid-age Australian adults

Gregore Mielke[1], Nicola Burton[2], Wendy Brown[1]

[1]School of Human Movement and Nutrition Sciences, The University of Queensland, Brisbane, Australia, [2]School of Applied Psychology, Griffith University, Brisbane Australia

0.2.4 Standardised accelerometer metrics: Health, global surveillance and moving towards an evidence-base for deriving physical activity guidelines directly from accelerometer data

Alex Rowlands[1], Stuart Fairclough[2], Tom Yates[1], Charlotte Edwardson[1], Lauren Sherar[3], Deirdre Harrington[1], Melanie Davies[1], Fehmidar Munir[3], Kamlesh Khunti[1], Victoria Stiles[4]

[1]University of Leicester, [2]Edge Hill University, [3]Loughborough University, [4]University of Exeter

0.2.5 A sequence analysis to examine the transition process between physical behaviours in the workplace: How are these processes linked to cardiometabolic risk factors?

Alexandra Clarke-Cornwell[1], Charlotte Edwardson[2], Malcolm Granat[1], Penny Cook[3]

[1]University of Salford, [2]University of Leicester, [3]The University of Salford

0.3 Machine learning/data mining

location: Auditorium 2

0.3.1 Mine the data, find the correlates of physical activity: A cross-sectional study

Vahid Farrahi[1], Maisa Niemelä[1], Mikko Kärmeniemi[1], Soile Puhakka[1], Maarit Kangas[1], Raija Korpelainen[1], Timo Jämsä[1]

[1]University of Oulu

0.3.2 User Verification of Actigraphy Data

Vittorio Paolo Illiano[1], Jonas Dorn[1]

[1]Novartis Pharma AG

ORAL SESSIONS

O.3.3 Deep Learning and Supervised Learning Models for Energy Expenditure Prediction in Preschool Children

Stewart Trost[1], Alok Chowdhury[1], Dian Tjondronegoro[2], Jinglan Zhang[1], Markus Hagenbuchner[3], Dylan Cliff[3]

[1]Queensland University of Technology, [2]Southern Cross University, [3]University of Wollongong

O.3.4 Unsupervised learning of behavior changes using raw accelerometry data

Jiawei Bai[1], Jonas Dorn[2]

[1]Johns Hopkins University, [2]Novartis Pharma AG

O.3.5 Building Machine Learning Models Using Standard Tools for Detection of Postures and Physical Activities from Long-term Accelerometer Recordings

Kerstin Bach[1], Paul Jarle Mork[1]

[1]Norwegian University of Science and Technology (NTNU)

Oral Sessions 4 - 6

WEDNESDAY, JUNE 26
14:00 – 15:00

O.4 Clinical applications (1)

location: 0.8 Rome

O.4.1 Objective quantifiable assessment of nocturnal movements in patients with Parkinson's disease using a wearable sensor

Inbar Hillel[1], Lynn Rochester[2], Bastiaan Bloem[3], Laura Avanzino[4], Alice Nieuwboer[5], Inbal Maidan[6], Shirley Shema Shiratzki[6], Talia Herman[6], Jesse Cederbaum[7], Nir Giladi[1], Jeffrey Hausdorff[1], Anat Mirelman[1]

[1]Tel Aviv Sourasky Medical Center, [2]Newcastle University Institute for Ageing, [3]Radboud University Medical Center; Donders Institute for Brain, Cognition and Behaviour, [4]University of Genoa, [5]Katholieke Universiteit Leuven, [6]Tel-Aviv Sourasky Medical Center, [7]Biogen Biotechnologies

O.4.2 Accelerometry measured walking cadence and mortality risk among U.S. adults

Pedro Saint-Maurice[1], Richard Troiano[2], David Bassett Jr.[3], Barry Graubard[2], Susan Carlson[4], Eric Shiroma[5], Janet Fulton[4], Charles Matthews[1]

[1]National Cancer Institute, NIH, [2]National Cancer Institute, [3]University of Tennessee, [4]Centers for Disease Control and Prevention, [5]National Institute on Aging

O.4.3 Is bias due to reverse causality evident in device-based studies of sedentary behavior, physical activity and mortality?

Charles Matthews[1], Pedro Saint-Maurice[1], Eric Shiroma[2], David Berrigan[3], Richard Troiano[4]

[1]National Cancer Institute, NIH, [2]National Institute on Aging, [3]National Cancer Institute NIH, [4]National Cancer Institute

O.4.4 Gait irregularity as a predictive marker of exertional heat stroke

Mark Buller[1], Rebecca Fellin[2], Joseph Seay[2], Alexander Welles[2], Beth Beidleman[2], Reed Hoyt[2], Royce Frazee[3], Charles Moore[3], Brian Telfer[4], Meghan Galer[5], Max Bursey[5], Jim Williamson[4]

[1]United States Army Research Institute of Environmental Medicine, [2]USARIEM, [3]U.S. Army, [4]MIT Lincoln Laboratory, [5]Martin Army Community Hospital

O.4.5 A home-based mHealth intervention in older cancer survivors to replace sedentary time with intermittent bouts of light physical activity

Cindy Blair[1], Elizabeth Harding[1], Charles Wiggins[1], Huining Kang[1], Emily Williams[1], Matthew Schwartz[1], David Medrano[1], Amy Tarnower[1], Anita Kinney[2]

[1]University of New Mexico, [2]Rutgers University

O.5 Gait Analysis

location: 0.9 Athens

O.5.1 Effects of Bout Size on Gait Metrics During Daily Activity

Fay Horak[1], Vrutangkumar Shah[2], James McNames[3], Martina Mancini[1], Patricia Carlson-Kuhta[1], John Nutt[1], Mahmoud El Gohary[1], Carolin Curtze[4]

[1]OHSU, [2]Oregon Health and Science University, [3]PSU, [4]University of Nebraska Omaha

O.5.2 How can texting affect your walking?

Patrick Crowley[1], Pascal Madeleine[2], Nicolas Vuillerme[1]

[1]National Research Center for the Work Environment/Aalborg University, [2]Aalborg University

O.5.3 Is every-day walking in older adults more analogous to dual-task walking or to usual walking? Elucidating the gap between gait performance in the lab and during 24/7 monitoring

Jeffrey Hausdorff[1], Inbar Hillel[1], Eran Gazit[1], Alice Nieuwboer[2], Laura Avanzino[3], Lynn Rochester[4], Andrea Cereatti[5], Ugo Croce[5], Marcel Rikkert[6], Bastiaan Bloem[7], Elisa Pelosin[8], Silvia Del Din[9], Pieter Ginis[10], Nir Giladi[1], Anat Mirelman[1]

[1]Tel Aviv Sourasky Medical Center, [2]Katholieke Universiteit Leuven, [3]University of Genoa, [4]Newcastle University Institute for Ageing, [5]University of Sassari, [6]Radboud university medical center, [7]Radboud University Medical Center; Donders Institute for Brain, Cognition and Behaviour, [8]IRCCS San Martino Teaching Hospital, [9]Newcastle University, [10]KU Leuven

O.5.4 Comparison between accelerometer and gyroscope for the analysis of gait regularity

Marco Rabufetti[1], Giovanni Scalera[1], Maurizio Ferrarin[1]

[1]IRCCS FONDAZIONE DON CARLO GNOCCHI

O.5.5 Gait speed assessed by a 4-meter walk test is not representative of daily-life gait speed in community-dwelling adults

Mirjam Pijnappels[1], Jeanine van Ancum[1], Kimberly van Schooten[2], Nini Jonkman[1], Bas Huijben[3], Rob van Lummel[3], Carel Meskers[4], Andrea Maier[5]

[1]Vrije Universiteit Amsterdam, [2]Neuroscience Research Australia, [3]McRoberts, [4]Amsterdam UMC, [5]The University of Melbourne

O.6 Algorithms (1)

location: Auditorium 2

O.6.1 Fast and robust algorithm for detecting standing periods using wrist-worn accelerometers

Marcin Straczkiewicz[1], Nancy Glynn[2], Tamara Harris[3], Vadim Zipunnikov[4], Jaroslaw Harezlak[5]

[1]Department of Epidemiology and Biostatistics, School of Public Health, Indiana University-Bloomington, [2]University of Pittsburgh, [3]Laboratory of Epidemiology, Demography, and Biometry, National Institute on Aging, [4]Johns Hopkins Bloomberg School of Public Health, [5]Indiana University

O.6.2 Improving hip-worn ActiGraph posture dcetection with artificial intelligence on a free-living dataset

Roman Kuster[1], Wim Grooten[2], Daniel Baumgartner[1], Victoria Blom[3], Cahit Atilgan[1], Maria Hagstromer[4], Örjan Ekblom[3]

[1]Zurich University of Applied Sciences, [2]Karolinska Institutet, [3]The Swedish School of Sport and Health Sciences, [4]Sophiahemmet University

O.6.3 Evaluating the performance of bout detection algorithms for wearable sensors: The transition pairing method

Paul Hibbing[1], Samuel LaMunion[1], Haileab Hilafu[1], Scott Crouter[1]

[1]University of Tennessee, Knoxville

O.6.4 Active Travel: Identifying periods of cycling using an accelerometer

Craig Speirs[1], David Loudon[1], Douglas Maxwell[1], Hans Savelberg[2], Malcolm Granat[3]

[1]PAL Technologies Ltd, [2]Maastricht University, [3]University of Salford

O.6.5 Visualisation to support automatic identification of time in bed using a thigh-worn accelerometer

David Loudon[1]

[1]PAL Technologies Ltd

Oral Sessions 7 - 9

WEDNESDAY, JUNE 26
15:05 – 16:00

O.7 Clinical Applications (2)

location: 0.8 Rome

O.7.1 The contribution of dog walking to daily moderate to vigorous physical activity in dog owners aged ≥ 65 who walk their dog regularly.

Philippa Dall[1], Amy Hume[1], Calum Leask[2], Sarah Ellis[3], Malcolm Granat[4], Daniel Mills[3]

[1]Glasgow Caledonian University, [2]NHS Grampian, [3]University of Lincoln, [4]University of Salford

O.7.2 Assessing the effect of pain on function via home-based active tasks measured by a wrist-worn accelerometer

Vittorio Paolo Illiano[1], Caroline Perraudin[1], Francesc Calvo[1], Emer O'Hare[1], Seamas Donnelly[2], Ronan Mullan[2], Oliver Sander[1], Brian Caulfield[3], Jonas Dorn[1]

[1]Novartis Pharma AG, [2]Tallaght Hospital, Trinity College Dublin, [3]University College Dublin

O.7.3 The optimal threshold of device-assessed physical activity required for weight loss at 24 months: A receiver operating characteristic curve analysis

Danielle Ostendorf[1], Janet Snell-Bergeon[1], Jan Lande[2], Anna Barón[1], Angela Bryan[3], Sarah Schmiege[1], Kevin Cummiskey[4], Diana Thomas[4], Dawn Comstock[1], Edward Melanson[1], Victoria Catenacci[1]

[1]University of Colorado Anschutz Medical Campus, [2]Bear Mountain Technologies, LLC, [3]University of Colorado Boulder, [4]United States Military Academy

O.7.4 Sensor-enabled physical activity recognition in children and adolescents with cerebral palsy

Stewart Trost[1], Alok Chowdhury[1], Emmah Baque[2], Matthew Ahmadi[1], Denise Brookes[1], Margaret O'Neil[3]

[1]Queensland University of Technology, [2]Griffith University, [3]Columbia University

O.7.5 It takes a week to obtain reliable estimates of tremor characteristics: A pilot study in organic and functional tremor patients

Zeus Dominguez-Vega[1], Gerrit Kramer[1], JanWillem Elting[1], Marina Tijssen[1], Natasha Maurits[1]

[1]University Medical Center Groningen

O.8 Research devices (2)

location: 0.9 Athens

O.8.1 How do body attachment site and signal aggregation metric affect accelerometer-based physical activity?

Jairo Migueles[1], Cristina Cadenas-Sanchez[1], Alex Rowlands[2], Pontus Henriksson[3], Eric Shiroma[4], Francisco Acosta[1], Maria Rodriguez-Ayllon[1], Irene Esteban-Cornejo[1], Âbel Plaza-Florido[1], Jose Juan Gil-Cosano[1], Ulf Ekelund[5], Vincent van Hees[6], Francisco Orteg

[1]PROFITH "PROmoting FITness and Health through physical activity" research group, [2]University of Leicester, [3]Karolinska Institutet, Huddinge, Sweden, [4]National Institute on Aging, [5]Norwegian School of Sport Sciences, [6]Netherlands eScience Center, Amsterdam, The Netherlands

O.8.2 Consistency of thigh-worn accelerometry data across ActiGraph Gt3x+, Axivity Ax3, and ActivPAL Micro4 devices using the Acti4 software

Patrick Crowley[1], Emmanuel Stamatakis[2], Jørgen Skotte[1], Mette Aadahl[3], Mark Hamer[4], Matthew Stevens[1], Vegar Rangul[5], Paul Mork[5], Andreas Holtermann[1]

[1]National Research Center for the Work Environment/Aalborg University, [2]University of Sydney, [3]Glostrup Hospital, [4]Loughborough University, [5]Norweigan Technical University Trondheim

O.8.3 Automatic estimation of step asymmetry in a split-belt treadmill experiment using high-resolution accelerometry data

Marta Karas[1], Ryan Roemmich[2], Ciprian Crainiceanu[1], Amy Bastian[2], Jacek Urbanek[1]

[1]Johns Hopkins University, [2]Kennedy Krieger Institute/Johns Hopkins University School of Medicine

O.8.4 Accuracy of processing methods and sensors differs by activity domain in free-living environments.

Sarah Keadle[1], Julian Martinez[2], Mami Takeda[1], Rachel Barnett[3]

[1]California Polytechnic State University San Luis Obispo, [2]University of Wisconsin - Milwaukee, [3]California Polytechnic State University

ORAL SESSIONS

O.8.5 Determination of device orientation, wrist of wear and hand dominance using raw accelerometer data

Joss Langford[1], Alexander Montoye[2], Charles Sweetland[3], Melitta McNarry[4], Kelly Mackintosh[4]

[1]Activinsights ltd, [2]Alma College, [3]Activinsights, [4]Swansea University

O.9 Validations

location: Auditorium 2

O.9.1 Comparing a short physical activity questionnaire with accelerometer measures as criterion validity: The Tromsø Study

Edvard Sagelv[1], Ulf Ekelund[2], Jonas Johansson[1], Søren Brage[3], Alexander Horsch[1], Laila Hopstock[1], Bente Morseth[1]

[1]UiT the Arctic University of Norway, [2]Norwegian School of Sport Sciences, [3]University of Cambrigde

O.9.2 Validation of the VitaBit Sit-Stand Tracker: Detecting Sitting, Standing, and Activity Patterns.

Nathalie Berninger[1], Gill ten Hoor[1], Guy Plasqui[1]

[1]Maastricht University

O.9.3 Time2Move: changing the way we assess sleep, physical activity and sedentary behaviour in children

Rachael Taylor[1], Kim Meredith-Jones[1], Barbara Galland[1], Anna Graham-DeMello[1], Jill Haszard[1], Tom Stewart[2], Lisa Mackay[2], Jono Neville[2], Scott Duncan[2]

[1]University of Otago, [2]Auckland University of Technology (AUT)

O.9.4 Validity of a sleep/non-wear algorithm designed for 24-hour wear when applied in a cohort of Swedish older adults wearing the activPAL3TM in a daytime wear protocol

Elisabeth Winkler[1], Ing-Mari Dohrn[2], Paul Gardiner[3], Charlotte Edwardson[4], Bronwyn Clark[1] Anna-Karin Welmer[2]

[1]The University of Queensland, [2]Karolinska Institutet, [3]Centre for Health Services Research, [4]University of Leicester

O.9.5 Validating estimates of sedentary time across multiple domains

Julian Martinez[1], Mami Takeda[2], Rachel Barnett[3], Scott Strath[1], Sarah Keadle[2]

[1]University of Wisconsin - Milwaukee, [2]California Polytechnic State University San Luis Obispo, [3]California Polytechnic State University

Oral Sessions 10 - 12

THURSDAY, JUNE 27

10:00 – 11:00

O.10 Special populations - Children

location: 0.8 Rome

O.10.1 Objectively measured physical activity patterns in overweight and obese children; baseline data of a multidisciplinary tailored intervention program

Gabrielle ten velde[1], Anita Vreugdenhil[1], Guy Plasqui[2], Elke Dorenbos[1]

[1]Maastricht UMC+, [2]Maastricht University

O.10.2 MOVI-daFIT! Baseline: Physical Activity and Lipid Profile among children 9-11 years old

Rubén Fernández[1], Carlos Pascual Morena[2], Alicia Del Saz Lara[2], Irene Sequí Domínguez[2], Celia Alvarez-Bueno[1], Miriam Garrido-Miguel[1], Carlos Berlanga-Macías[1], Esther Galvez-Adalia[1], Ana Diez-Fernandez[1]

[1]Health and Social Research Center, [2]Universidad de Castilla - La Mancha

O.10.3 Comparison of WHO guideline adherence in self-reported vs. accelerometer-measured physical activity among German children and adolescents

Alexander Burchartz[1], Bastian Anedda[2], Doris Oriwol[1], Simon Kolb[1], Steffen Schmidt[1], Alexander Woll[1]

[1]Karlsruher Institute of Technology (KIT), [2]Institute of Sports and Sportscience (IfSS)

O.10.4 Evaluation of laboratory-based and free-living algorithms for energy expenditure estimation in preschool children under free-living conditions

Matthew Ahmadi[1], Alok Chowdhury[1], Dylan Cliff[2], Markus Hagenbuchner[2], Stewart Trost[1]

[1]Queensland University of Technology, [2]University of Wollongong

O.10.5 Longitudinal effects of physical activity patterns on adiposity and fitness from preschool to school-age

Sara King-Dowling[1], Nicole Proudfoot[1], Brian Timmons[1]

[1]Child Health & Exercise Medicine Program, McMaster University

O.11 24-hour activity cycle (1)

location: 0.9 Athens

O.11.1 Levels of physical activity, sedentary behavior and sleep among Finnish adults measured 24/7 by a tri-axial accelerometer

Pauliina Husu[1], Kari Tokola[1], Jaana Suni[1], Henri Vähä-Ypyä[1], Harri Sievänen[1], Tommi Vasankari[1]

[1]The UKK Institute for Health Promotion Research

O.11.2 Calibration of self-reported physical behaviours among office workers: A compositional data analysis

David Hallman[1], Pieter Coenen[2], Allard van der Beek[2], Jennie Jackson[1], Svend Erik Mathiassen[1]

[1]University of Gävle, [2]VU University Medical Centre

O.11.3 Daily activity levels of undergraduate first-year students: An observational study

Hui Qing Chim[1], Hans Savelberg[1], Pascal van Gerven[1], Mirjam oude Egbrink[1], Renate de Groot[1], Bjorn Winkens[1]

[1]Maastricht University

O.11.4 Physical-behavior profiles and aerobic capacity: A latent profile analysis of 24-hour time-use composition among Danish workers

Nidhi Gupta[1], David Hallman[2], Dorothea Dumuid[3], Akshay Vij[3], Charlotte Rasmussen[4], Marie Jørgensen[5], Mette Korshøj[4], Andreas Holtermann[6]

[1]The National Research Centre for the Working Environment, [2]University of Gävle, [3]University of South Australia, [4]National research centre for the working environment, [5]University of Copenhagen, [6]National Research Center for the Work Environment/ Aalborg University

O.11.5 Estimated effects of replacing sedentary time with walking on risk factors for coronary heart disease and stroke: A cross-sectional compositional data analysis of accelerometer data from the Copenhagen City Heart Study

Melker Johansson[1], Karen Søgaard[1], Eva Prescott[2], Peter Schnohr[2], Jacob Marott[2], Andreas Holtermann[3], Mette Korshøj[4]

[1]University of Southern Denmark, [2]Bispebjerg and Frederiksberg Hospital, [3]National Research Center for the Work Environment/ Aalborg University, [4]National research centre for the working environment

O.12 Research technologies

location: Auditorium 2

O.12.1 Evidence of the respiratory magnetometer plethysmography for the estimation of minute ventilation during low to moderate intensities.

Aya Houssein[1], Di Ge[2], Steven Gastinger[3], Remy Dumond[3], Jacques Prioux[1]

[1]Ecole normale supérieure de Rennes, [2]Laboratoire traitement du signal et de l'image (LTSI), [3]Laboratoire Mouvement Sport Santé (M2S)

O.12.2 Assessing physical activity using floor vibrations in a smart home setting

Julien Tripette[1], Mio Sasaki[1], Nobuhisa Motooka[1], Yuji Ohta[1]

[1]Ochanomizu University

O.12.5 Which vertical ground reaction forces variable is most associated with the in vivo 3D hip joint contact forces?

Sónia Alves[1], Peter Raffalt[1], Philipp Damm[1], Alwina Bender[1], Georg Duda[1], Alison Agres[1]

[1]Julius Wolff Institute - Charité Universitätsmedizin Berlin

Oral Sessions 13 - 15

THURSDAY, JUNE 27

14:00 – 15:00

O.13 Real world applications (1)

location: 0.8 Rome

O.13.2 Measuring the response to prompts to stand: An exploration of a pilot study of UK office workers

Philippa Dall[1], Catriona O'DOlan[1], Margaret Grant[1], Maggie Lawrence[1]

[1]Glasgow Caledonian University

O.13.3 The contribution of commuting to total daily moderate-to-vigorous physical activity

Abolanle Gbadamosi[1], Alexandra Clarke-Cornwell[1], Paul Sindall[1], Malcolm Granat[1]

[1]University of Salford

O.13.4 Bouts are out: What is the impact of removing the bout requirement from the Physical Activity Guidelines?

Kate Lyden[1], David Loudon[2], Malcolm Granat[3]

[1]KAL Research & Consulting, [2]PAL Technologies Ltd, [3]University of Salford

O.14 Algorithms (2)

location: 0.9 Athens

O.14.1 Comparison of free-living activity classification between sojourns and epochs using a wrist-worn accelerometer

Robert Marcotte[1], Greg Petrucci Jr.[1], Melanna Cox[1], Patty Freedson[1], John Staudenmayer[1], John Sirard[1]

[1]University of Massachusetts Amherst

O.14.2 Three distinct physical behavior types in fatigued patients with multiple sclerosis

Hanneke Braakhuis[1], Monique Berger[2], Jetty van Meeteren[3], Vincent de Groot[4], Heleen Beckerman[4], Johannes Bussmann

[1]ErasmusMC / The Hague University, [2]The Hague University, [3]ErasmusMC, [4]Amsterdam University Medical Centers, Erasmus MC University Medical Center

O.14.3 Real-world detection and analysis of locomotion using single wrist sensor: Validation and application to a large population

Abolfazl Soltani[1], Hooman Dejnabadi[1], Anisoara Ionescu[1], Pedro Marques-Vidal[1], Peter Vollenweider[1], Kamiar Aminian[1]

[1]École polytechnique fédérale de Lausanne, EPFL

O.14.4 Population-specific algorithm development: Do activity classification models developed in children generalise to the adult population (and vice versa)

Tom Stewart[1], Anantha Narayanan[1], Lisa Mackay[1]

[1]Auckland University of Technology (AUT)

O.14.5 A system for data harmonization and federated analysis of accelerometer and GPS data

Jasper Schipperijn[1], Emiliano Molinaro[1], Jesper van der Zwan[1], Jens Hjort Schwee[1], Mikkel Baun Kjærgaard[1]

[1]University of Southern Denmark

O.15 Computer vision/video analysis

location: Auditorium 2

O.15.1 Challenges and opportunities using webcams and time lapse cameras to evaluate physical behaviour in public open space

J. Aaron Hipp[1], Anna Petrasova[1], Pratik Bhave[1], Ladan Ghahramani[1], Elizabeth Mazak[1]

[1]North Carolina State University

O.15.2 Applying computer vision techniques to predict physical activity from video images

Gregory Dominick[1], Philip Saponaro[1], Haoran Wei[1], Richard Suminski Jr.[1]

[1]University of Delaware

O.15.3 Automating direct observations of physical activity in settings using computer vision

Jordan Carlson[1], Bo Liu[2], Nuno Vasconcelos[2], James Sallis[2], J. Aaron Hipp[3], Jacqueline Kerr[2], Amy Papa[1], Kelsey Dean[1]

[1]Children's Mercy Kansas City, [2]University of California San Diego, [3]North Carolina State University

ORAL SESSIONS

O.15.4 From pixels to sidewalks: Using Google Street View and Computer Vision to Create a National Sidewalk Inventory

J. Aaron Hipp[1], S. Saeed Oloonabadi[1], Hrishikesh Garud[1], Pratik Bhave[1]

[1]North Carolina State University

O.15.5 Insights on free-living behavior from a novel direct observation coding system

Robert Marcotte[1], Greg Petrucci Jr.[1], Melanna Cox[1], Patty Freedson[1], John Staudenmayer[1], John Sirard[1]

[1]University of Massachusetts Amherst

Oral Sessions 16 - 18

THURSDAY, JUNE 27
15:05 – 16:00

O.16 Real world applications (2)

location: 0.8 Rome

O.16.1 Self-perceived gait stability modulates the effect of daily-life gait quality on falls in older adults

Roel Weijer[1], Marco Hoozemans[1], Jaap van Dieën[1], Mirjam Pijnappels[2]

[1]VU Amsterdam, [2]Vrije Universiteit Amsterdam

O.16.2 Context matters - The effect of context-specificity on the association between the built environment and physical activity in individuals with and without health-related problems

Nicole Stappers[1], Jasper Schipperijn[2], Stef Kremers[1], Marleen Bekker[3], Maria Jansen[4], Dave Van Kann[5]

[1]Maastricht University, [2]University of Southern Denmark, [3]Wageningen University, [4]Academic Collaborative Center for Public Health, [5]Fontys University of Applied Sciences

O.16.3 Habitual physical activity patterns of vocational education students and the association with executive functioning: The PHIT2LEARN study

Jérôme Gijselaers[1], Hans Savelberg[2], Amika Singh[3], Renate de Groot[2]

[1]Open University of the Netherlands, [2]Maastricht University, [3]VU University Medical Centre Amsterdam

O.16.4 Monitoring of walking performances of ten non-professional athletes during the 2018 Berlin 100-km Mammutmarsch

Marco Rabufetti[1], Martina Maggioni[2], Giampiero Merati[3], Mathias Steinach[2]

[1]IRCCS Fondazione Don Carlo Gnocchi, [2]Charité Universitätsmedzin Berlin, [3]Università degli Studi di Milano

O.16.5 Physical activity and sedentary patterns of semi-nomad pastoralist Senegalese Fulanis are deeply altered in urban context

Maël Garnotel[1], Emmanuel Cohen[2], Abdou Ka[3], Audrey Bergouignan[2], Priscilla Duboz[3], Enguerran Macia[3], Gilles Boetsch[3], Isabelle Chery[2], Alexandre Zahariev[2], Stéphane Blanc[2], Simon Chantal[1]

[1]CRNH Rhone-Alpes, [2]IPHC CNRS, [3]CNRS

O.17 Upper limb monitoring

location: 0.9 Athens

O.17.1 Development of a taxonomic structure to support automatic recognition of eating behaviors

Kyle Winfree[1], Tianna Jordening[1], Natalia Dmitrieva[1], Timothy Behrens[1]

[1]Northern Arizona University

O.17.2 Daily activity monitoring of robotic arm support users with muscular weakness

Johannes Essers[1], Anneliek Peters[2], Alessio Murgia[2], Kenneth Meijer[1]

[1]Maastricht University Medical Centre+, [2]University Medical Center Groningen

O.17.3 Validity of the Apple Watch® for monitoring push counts in people using manual wheelchairs

Sjaan Gomersall[1], Kati Karinharju[1], Alexander Boughey[1], Kelly Clanchy[2], Stewart Trost[3], Sean Tweedy[1]

[1]The University of Queensland, [2]Griffith University, [3]Queensland University of Technology

O.17.4 How does the upper limb activity of adolescents with upper limb absence differ from anatomically intact adolescents, and does this change during sport?

Alexandra Clarke-Cornwell[1], Natalie Chinn[1], Alix Chadwell[1], Laurence Kenney[1], Malcolm Granat[1], John Head[1]

[1]University of Salford

O.17.5 Towards an activity tracker for wheelchair users

Herwin Horemans[1], Marika Leving[2], Kristel Lankhorst[3], Johannes Bussmann[4]

[1]Erasmus MC, [2]UMCG, [3]HU University of Applied Sciences, [4]Erasmus MC University Medical Center

O.18 Assessment of sleep

location: Auditorium 2

O.18.1 Comparison of non-wear and sleep detection algorithms in ActivPAL data

Norman Wirsik[1], Jan Behrens[1], Hermann Pohlabeln[1]

[1]Leibniz Institute for Prevention Research and Epidemiology - BIPS

O.18.2 Can accelerometry data alone detect sleep stages?

Michelle Trevenen[1], Kevin Murray[1], Berwin Turlach[1], Leon Straker[2], Peter Eastwood[1]

[1]University of Western Australia, [2]Curtin University

O.18.3 Validation of a count-scaled algorithm to assess sleep in children using polysomnography

Kim Meredith-Jones[1], Claire Smith[1], Rachael Taylor[1], Barbara Galland[1]

[1]University of Otago

O.18.4 OpenCoDa: Advancing compositional analysis of 24-hour time-use and movement behaviour data through open science

Sebastien Chastin[1], Duncan McGregor[2], Javier Palarea-Albaladejo[3], Philippa Dall[2]

[1]Glasgow Caledonian University, Ghent University, [2]Glasgow Caledonian University, [3]Biomathematics and Statistics Scotland

O.18.5 Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity

Vadim Zipunnikov[1], Junrui Di[1]

[1]Johns Hopkins University, Bloomberg School of Public Health

Oral Sessions 19 – 21

FRIDAY, JUNE 29
10:00 – 11:00

O.19 Special populations

location: 0.8 Rome

O.19.1 The relationship between gait cadence variability and mobility impairment in acute stroke patients

Andrew Kerr[1], Jesse Dawson[2], Terry Quinn[2], Craig Speirs[3]

[1]University of Strathclyde, [2]University of Glasgow, [3]PAL Technologies Ltd

O.19.2 The effects of multiple sclerosis on community ambulation: beyond reduced activity

Inbar Hillel[1], Shirley Shema-Shiratzky[2], Anat Mirelman[1], Keren Regev[2], Arnon Karni[2], Jacob Sosnoff[3], Jeffrey Hausdorff[1]

[1]Tel Aviv Sourasky Medical Center, [2]Tel-Aviv Sourasky Medical Center, [3]University of Illinois at Urbana-Champaign

O.19.3 Week and weekend day cadence patterns long-term post-bariatric surgery

Malcolm Granat[1], Ryan Reid[2], Tiago Barreira[3], Charlotte Haugan[2], Tyler Reid[4], Ross Anderson[2]

[1]University of Salford, [2]McGill University, [3]University of Syracuse, [4]Stanford University

O.19.4 Added value of a within-subject approach of stress and physical behaviour in stroke patients

Johannes Bussmann[1], Marlou Limpens[2], Uli Ebner-Priemer[3], Tuna Aliskan Turkbey T[4], Marco Giurgiu , Ingrid Brands[4], Gerard Ribbers[2]

[1]Erasmus MC University Medical Center, [2]Erasmus MC University Medical Center Rotterdam, [3]Karlsruher Institute of Technology, [4]Libra Revalidatie & Audiologie, Karlsruhe Institute of Technology (KIT)

O.19.5 Comparison of upper limb use in people with different levels of upper limb impairment early post-stroke

Sandra Brauer[1], Lay Fong Chin[1], Kathryn Hayward[2]

[1]University of Queensland, [2]University of Melbourne

O.20 24-hour activity cycle (2)

location: 0.9 Athens

O.20.1 One Million Days of Mortality: An open science federated analysis of the impact of daily time use on health

Duncan McGregor[1], Javier Palarea-Albaladejo[2], Philippa Dall[1], Sebastien Chastin[3]

[1]Glasgow Caledonian University, [2]Biomathematics and Statistics Scotland, [3]Glasgow Caledonian University, Ghent University

O.20.2 Issues with analysing complex 24-hour accelerometry data to assess sleep, sedentary time, and physical activity

Rachael Taylor[1], Jill Haszard[1], Kim Meredith-Jones[1], Barbara Galland[1]

[1]University of Otago

O.20.3 The ProPASS multi-dimensional 24-hour movement behavior construct

Andreas Holtermann[1], Nidhi Gupta[2], Mark Hamer[3], Vegar Rangul[4], Annemarie Koster[5], Emmanuel Stamatakis[6]

[1]National Research Center for the Work Environment/Aalborg University, [2]The National Research Centre for the Working Environment, [3]Loughborough University, [4]Norweigan Technical University Trondheim, [5]Maastricht University, [6]University of Sydney

O.20.4 Sleep versus activity versus sedentary time: A non-parametric approach to isotemporal substitution regression

John Staudenmayer[1], Charles Matthews[2], Pedro Saint-Maurice[2]

[1]University of Massachusetts Amherst, [2]National Cancer Institute, NIH

O.21 Consumer technologies

location: Auditorium 2

O.21.1 Validation of the Walk@WorkApp + MetaWearC motion sensor for real time measurements of occupational sitting, standing and movement.

Judit Bort-Roig[1], Emilia Chirveches-Pérez[1], Francesc Garcia-Cuyàs[2], Kieran Dowd[3], Anna Puig-Ribera[1]

[1]Universitat de Vic, [2]Hospital Sant Joan de Deu de Barcelona, [3]Athlone Institute of Technology

O.21.2 A comparison of Smartphone-based and Accelerometer-based physical activity measures in bipolar disorder

Holger Hill[1], Esther Mühlbauer[2], Emanuel Severus[2], Michael Bauer[2], Ulrich Ebner-Priemer[3]

[1]Karlsruhe Institute of Technology (KIT), [2]University Medical Center Dresden, [3]Department of Sports and Sports Science, Karlsruhe Institute of Technology (KIT)

O.21.3 Development of a GPS measurement based smartphone application to conduct outdoor walking session in peripheral artery disease patients

Alexis Le Faucheur[1], Antoine Delmas[2], Meghan Craughwell[3], Ségolène Chaudru[2], Guillaume Mahé[2], Guy Carrault

[1]Ecole normale supérieure de Rennes, [2]University of Rennes, [3]University of Limerick

O.21.4 Validity of consumer monitors for estimating steps in youth

Scott Crouter[1], Brandon Clendenin[1], Paul Hibbing[1], Samuel LaMunion[1]

[1]The University of Tennessee Knoxville

O.21.5 Examining the congruence of relative exercise intensity estimates between chest and wrist-worn heart rate monitors

Gregory Dominick[1], Kyle Winfree[2], Matthew Saponaro[1], Sophia Frohna[2]

[1]University of Delaware, [2]Northern Arizona University

POSTER SESSIONS

Poster Session 1

WEDNESDAY, JUNE 26
12:30 – 13:15

1-01 Continuous Overall Net Physical Activity (CONPA): An exploration of activity variability

Cynthia Fritschi[1], Cynthia Fritschi[1], Chang Park[1], Ulf Bronas[1], Laurie Quinn[1]

[1]University of Illinois at Chicago

1-03 Comparisons of accelerometer sleep classification algorithms in preschool-aged children

Nicholas Kuzik[1], Nicholas Kuzik[1], Valerie Carson[1]

[1]University of Alberta

1-05 Objectively measured 24-hour movement behaviors in children with chronic disease: A case-control study

Rabha Elmesmari[1], John Reilly[2], James Paton[1]

[1]University of Glasgow, [2]University of Strathclyde

1-07 Preparation and release of NHANES and NNYFS wrist accelerometer data

Rick Troiano[1], Stephen Intille[2], Dinesh John[2], Binod Chhetry[2], Qu Tang[2]

[1]National Institute of Health, [2]Northeastern University

1-09 Changes in chronological within day patterns of physical behaviour with age

Ben Stansfield[1], Ceri Sellers[1]

[1]Glasgow Caledonian University

1-11 Defining walking bouts in free-living activities

Abolanle Gbadamosi[1], Alexandra Clarke-Cornwell[1], Malcolm Granat[1]

[1]University of Salford

1-15 Activities of daily living in elderly: Development and validation of an algorithm for classifying physical activity

Wouter Bijnens[1], An Stevens[1], Jos Aarts[1], Kenneth Meijer[1]

[1]Maastricht University

1-17 Aligning raw acceleration from two independent devices

Jan Brønd[1], Jan Brønd[1], Anders Grøntved[1]

[1]University of Southern Denmark

1-19 Feasibility of ambulatory monitoring devices in monitoring the rehabilitation of elderly patients after hip fracture treatment

Dieuwke van Dartel[1], Han Hegeman[2], Miriam Vollenbroek-Hutten[1]

[1]Ziekenhuisgroep Twente / University of Twente, [2]Ziekenhuisgroep Twente

1-21 Metal ion concentrations after hip resurfacing and physical activity: Correlation with high intensity and walking speed but not daily steps.

Bernd Grimm[1], Jetse Jelsma[2], Martijn Schotanus[2], Sander van Kuijk[3], Ivo Buil[4], Ide Heyligers[2], Bernd Grimm[1]

[1]None, [2]Zuyderland Medical Center, Dept. Orthopaedic Surgery, [3]University of Maastricht, Dept. Clinical Epidemiology, [4]Zuyderland Medical Center

1-23 The feasibility of ambulatory physical activity monitoring devices in studies on soldiers

Thomas Wyss[1], Lilian Roos[1], Karl Friedl[2], Mark Buller[2], Delves Simon[3], Bertil Veenstra[4]

[1]Swiss Federal Institute of Sport Magglingen SFISM, [2]United States Army Research Institute of Environmental Medicine, [3]Institute of Naval Medicine, Alverstoke, Hampshire, United Kingdom, [4]Institute of Training Medicine & Training Physiology TGTF, Royal Ne

1-25 ActivPAL does not measure MVPA equally to ActiGraph.

Johan Sunesson[1], Frida Bergman[1], Philippa Dall, Tommy Olsson, Ann Sörlin

[1]Umeå universitet

1-26 Advancing the measurement of physical activity in outdoor, public environments using high-tech video capture and analysis

Richard Suminski Jr.[1], Gregory Dominick[1], Philip Sapanaro[1]

[1]University of Delaware

1-27 Exploration of ActiGraph GT9X primary accelerometer data stability

Samuel LaMunion[1], Scott Crouter[1]

[1]University of Tennessee, Knoxville

1-29 Comparison of raw accelerometry from four research-grade devices

Karl Friedl[1], James Williamson[2], Johanna Bobrow[2], Kajal Claypool[2], Brian Telfer[2], Karl Friedl[1]

[1]US Army Research Institute of Environmental Medicine, [2]MIT Lincoln Laboratory

1-31 Calibration of wrist and hip worn accelerometers raw acceleration cut-points for the assessment of sedentary behaviour and physical activity in 5-7 years old children

Matteo Crotti[1], Foweather Lawrence[1], James Rudd[1], Liezel Hurter[1], Sebastian Schwarz[2], Lynne Boddy[1]

[1]Liverpool John Moores University, [2]University of Munster

1-31 Detecting interruption during moderate intensity walking by waist- and wrist-mounted accelerometer

Makoto Ayabe[1], Yoshiki Okita[1], Takeshi Oyama[1], Hideaki Kumahara[2]

[1]Okayama Prefectural University, [2]Nakamura Gakuen University

1-33 Modeling behavior of volleyball players for analysis and interactive multimodal feedback

Fahim Salim[1], Roby Delden[1], Dennis Reidsma[1], Bert-Jan Beijnum[1]

[1]University of Twente

1-35 Machine learning categorizes total knee replacement patients by likelihood of functional improvement at three-months post-surgery based on preoperative instrumented timed-up-and-go tests

Riley Bloomfield[1], Harley Williams[1], Jordan Broberg[1], Brent Lanting[1], Matthew Teeter[1]

[1]Western University

1-37 Recognition of human activities using plantar pressure measurements: a smart-shoes study

Dian Ren[1], Emi Anzai[2], Nathanael Aubert-Kato[1], Yuji Ohta[1], Julien Tripette[1]

[1]Ochanomizu university, [2]National Institute of Advanced Industrial Science and Technology

1-39 Portable monitoring for air pollution exposure assessment during active transportation: procedures, technology integration and data harmonization of diverse sources.

Nicolas Aguilar-Farias[1], Francisco Rubilar-Rocha[2], Nicolas Aguilar-Farias[1]

[1]Universidad de La Frontera, [2]University of La Frontera

1-41 Comparison of sedentary time between thigh-worn and wrist-worn accelerometers

Anna Pulakka[1], Kristin Suorsa[1], Tuija Leskinen[1], Jaana Pentti[2], Andreas Holtermann[3], Juha Sunikka[1], Jussi Vahtera[1], Sari Stenholm[1]

[1]University of Turku, [2]University of Helsinki, [3]National Research Center for the Work Environment/Aalborg University

1-43 From measurement to intervention: an Intervention Mapping approach for data-driven sedentary behavior consulting

Nathalie Berninger[1], Gill ten Hoor[1], Rob Ruiter[1], Gerjo Kok[1], Guy Plasqui[1]

[1]Maastricht University

1-45 Compositional analysis of sedentary behavior and physical activity during work and leisure among male and female office workers

Elin Johansson[1], Svend Erik Mathiassen[1], Charlotte Lund Rasmussen[2], Eugene Lyskov[1], David Hallman[1]

[1]University of Gävle, [2]National Research Centre for the Working Environment

1-47 Long-term continuous activity profiling in a technology supported physical lifestyle intervention

Nicholas Smith[1], Douglas Maxwell[1], David Loudon[1]

[1]PAL Technologies Ltd

1-49 A free-living investigation of methods to estimate moderate-to-vigorous physical activity from an actigraph accelerometer

Greg Petrucci Jr.[1], Robert Marcotte[1], Melanna Cox[1], John Staudenmayer[1], Patty Freedson[1], John Sirard[1]

[1]University of Massachusetts Amherst

1-51 Sedentary behavior negatively impacts sleep quality in college students as derived from accelerometry

Trent Hargens[1], Matthew Scott[1], Valerie Olijar[1], Matthew Bigman[1], Elizabeth Edwards[1]

[1]James Madison University

1-53 Does a school-based standing desk intervention modify classroom standing and sitting time and physical activity during waking hours over a full school year?

Sharon Parry[1], Joanne McVeigh[1], Beatriz IR de Oliveira[1], Jolyn Ee[1], Leon Straker[1]

[1]Curtin University

1-55 Step count to characterize physical activity in people with Parkinson's disease

Sandra Brauer[1], Robyn Lamont[1], Elissa Addison[1], Susie Lee[1]

[1]University of Queensland

1-57 Moderate-to-vigorous physical activity is much greater among Bolivian Amerindian than US adolescents, but sex differences and age-related decline are similar

Ann Caldwell[1], Kate Lyden[2], Daniel Cummings[3], Hillard Kaplan[4], Michael Gurven , Paul Hooper[3]

[1]University of Colorado, [2]University of Massachusetts, Amherst., [3]University of New Mexico, [4]Chapman University, University of California, Santa Barbara

1-59 Free-living physical activity one year following total knee arthroplasty in patients with osteoarthritis

Bodor Bin sheeha[1], Anita Williams[2], David Johnson[3], Ahmad Bin nasser[4], Malcolm Granat , Richard Jones[2]

[1]Princess Nora bint Abdul Rahman University, KSA, [2]University of Salford Manchester, [3]Stockport NHS Foundation Trust, [4]King Khalid University Hospital, University of Salford

1-61 Associations of physical activity patterns and risk of falls in free-living older adults in Hong Kong

Zhihui Lu[1], Jason Leung[1], Timothy Kwok[1]

[1]The Chinese University of Hong Kong

1-63 Physical activity post hip fracture during hospitalisation, rehabilitation and beyond: a series of observational studies

Casey Peiris[1], Nicholas Taylor[1]

[1]La Trobe University

1-65 Influence of activity monitor intervention on physical activity, dietary intake and psychological state in young adult women

Hideaki Kumahara[1], Makoto Ayabe[2]

[1]Nakamura Gakuen University, [2]Okayama Prefectural University

Poster Session 2

WEDNESDAY, JUNE 26
13:15 – 14:00

2-02 Timing of activity patterns are associated with perceived physical fatigability in older adults

Jessica Graves[1], Robert Krafty[1], Jaroslaw Harezlak[2], Eric Shiroma[3], Nancy Glynn[1]

[1]University of Pittsburgh, [2]Indiana University, [3]National Institute on Aging

2-04 Reclining but not sitting have harmful associations with cholesterol and triglycerides

Henri Vähä-Ypyä[1], Harri Sievänen[1], Pauliina Husu[1], Kari Tokola[1], Jaana Suni[1], Tommi Vasankari[1]

[1]UKK Institute

2-06 Association between mortality and time-use composition of the 24 hour day

Duncan McGregor[1], Javier Palarea-Albaladejo[2], Philippa Dall[1], Borja del Pozo-Cruz[3], Sebastien Chastin[4]

[1]Glasgow Caledonian University, [2]Biomathematics and Statistics Scotland, [3]Australian Catholic University, [4]Glasgow Caledonian University, Ghent University

2-08 Compositional data group based trajectory analysis for physical behaviours.

POSTER SESSIONS

Sebastien Chastin[1], Duncan McGregor[2], Javier Palarea-Albaladejo[3], Matthew Buman[4], Borja del Pozo-Cruz[5]

[1]Glasgow Caledonian University, Ghent University, [2]Glasgow Caledonian University, [3]Biomathematics and Statistics Scotland, [4]Arizona State University, Glasgow Caledonian University, [5]Australian Catholic University

2-12 Automatic identification of valid wear days in thigh worn accelerometer data

David Loudon[1], Douglas Maxwell[1]

[1]PAL Technologies Ltd

2-14 Validation of a novel lightweight template-based algorithm for free-living gait detection.

Michael Dunne-Willows[1], Jian Shi[2], Aodhan Hickey[3], Paul Watson[4], Lynn Rochester , Silvia Del Din

[1]EPSRC Centre for Doctoral Training in Cloud Computing for Big Data, Newcastle University, [2]School of Mathematics, Statistics and Physics, Newcastle University., [3]Department of Health Intelligence, HSC Public Health Agency,, [4]2School of Computing Science,

2-16 Accuracy of first-person point-of-view video from a body-worn camera as a criterion for free-living human physical behavior activity type and context labeling

Diego Arguello[1], Samuel Rosenberg[1], Dinesh John[1]

[1]Northeastern University

2-18 The Light-intensity Physical Activity Trial (LiPAT); lowering cardiovascular disease risk in type 2 diabetes through increasing light-intensity physical activity

Evelien Vandercappellen[1], Annemarie Koster[1], Ronald Henry[2], Coen Stehouwer[2]

[1]Maastricht University, [2]Maastricht University Medical Center+

2-20 Effects of progressive intensity exercise training on glycemic control and free-living physical activity in older adults with prediabetes

Seth Creasy[1], Jennifer Blankenship[2], Victoria Catenacci[2], Kenneth Wright Jr.[3], Jane Reusch[1], Kerry Hildreth[1], Edward Melanson[2]

[1]University of Colorado- Anschutz Medical Campus, [2]University of Colorado Anschutz Medical Campus, [3]University of Colorado-Boulder

2-22 Accuracy of heart rate and energy expenditure estimations of wrist-worn and arm-worn Apple Watches

Kayla Nuss[1], Joseph Sanford[1], Luke Archambault[1], Ethan Schlemer[1], Sophie Blake[1], Jimikaye Courtney[1], Nick Hullett[1], Kaigang Li[1]

[1]Colorado State University

2-24 The relationship between actual physical activity and perceived physical functioning and disease activity in persons with ankylosing spondylitis

Kyra Theunissen[1], Guy Plasqui[1], Kenneth Meijer[2], Simon van Genderen[1], Annelies Boonen[1]

[1]Maastricht University, [2]Maastricht University Medical Centre+

2-28 A measurement of post-stroke arm activity in daily life: An exploration study using a low-cost commercial wearable device

Shuya Chen[1], Tong Jing Lim[1], Chia-Ming Chie[1], Wen-Dien Chang[2], Chien-Lin Lin[3]

[1]China Medical University, [2]National Taiwan University of Sport, [3]China Medical University Hospital

2-30 Understanding criteria for classifying children as physically active: a comparison of self-report and device-derived measures.

Nicolas Aguilar-Farias[1], Damian Chandia-Poblete[1]

[1]Universidad de La Frontera

2-32 Development of an arm activity tracker that applies direct personalized feedback based on objectively measured arm use data to stimulate the use of the affected arm after stroke

Ruben Regterschot[1], Gerard Ribbers[2], Marc Evers[3], Ruud Selles[1], Johannes Bussmann[4]

[1]Erasmus MC, [2]Erasmus MC University Medical Center Rotterdam, [3]Rijndam Rehabilitation, [4]Erasmus MC University Medical Center

2-36 Activity classification models developed in controlled laboratory settings: how well do they generalise to free-living conditions?

Tom Stewart[1], Anantha Narayanan[1], Lisa Mackay[1], Scott Duncan[2]

[1]Auckland University of Technology (AUT), [2]Auckland University of Technology

2-38 Confirmation of Self-Reported Ambulatory Exercise Bouts During Ecological Momentary Assessment

Lindsay Toth[1], Lucas Sheridan[1], Kelley Strohacker[1]

[1]The University of Tennessee, Knoxville

2-40 Association between objectively assessed activity data and mortality risk: a 15-year follow-up using a compositional data analysis approach

Maria Hagstromer[1], Philip von Rosen[2], Ing-Mari Dohrn[2]

[1]Sophiahemmet University, [2]Karolinska Institutet

2-42 Relationship between aerobic fitness indicators and intra-abdominal pressure in healthy adult women

Ali Wolpern[1], Johanna de Gennaro[1], Timothy Brusseau[1], Wonwoo Byun[1], Marlene Egger[1], Robert Hitchcock[1], Ingrid Nygaard[1], Xiaoming Sheng[1], Janet Shaw[1]

[1]University of Utah

2-44 Actigraph GT9X wear time and steps in elementary school children: Influence of using step feedback on the device display

Michael Schmidt[1], Benjamin Boudreaux[1], Zhixuan Chu[1], Kyle Johnsen[1], Stephen Rathbun[1], Sun Joo (Grace) Ahn[1]

[1]University of Georgia

2-46 Using Bluetooth sensing to determine co-location of workers

Bronwyn Clark[1], Charita Deshpande[2], Elisabeth Winkler[1]

[1]The University of Queensland, [2]The University of Queensland, School of Public Health

2-48 Comparison of available ActiGraph cut points for accelerometer data acquired from children

Becky Breau[1], Hannah Coyle-Asbil[1], Jess Haines[1], David Ma[1], Lori Ann Vallis[1]

[1]University of Guelph

2-50 Accelerometer-derived physical activity levels in cancer survivors: A meta-analysis

Nga Nguyen[1], Angelyna Lee[1], Catherine Granger[2], Julie Broderick[3], Tom O?Dwyer[3], Brigid Lynch[1]

[1]Cancer Council Victoria, [2]The University of Melbourne, [3]Trinity College Dublin

2-52 Equivalency of sleep estimates from three research-grade accelerometers worn on the non-dominant and dominant wrist

Tatiana Plekhanova[1], Alex Rowlands[1], Tom Yates[1], Andrew Hall[2], Emer Brady[1], Melanie Davies[1], Kamlesh Khunti[1], Charlotte Edwardson[1]

[1]University of Leicester, [2]University Hospitals of Leicester

2-54 Physical activity and anthropometric measures of body composition, muscle strength and muscle mass in colorectal cancer survivors up to 2 years post-treatment: A longitudinal analysis

Eline van Roekel[1], Martijn J.L. Bours[1], José J.L. Breedveld-Peters[1], Linda van Delden[1], Kenneth Meijer[1], Stéphanie O. Breukink[1], Maryska L.G. Janssen-Heijnen[2], Eric Keulen[3], Sabina Rinaldi[4], Paolo Vineis[5], Ilja C.W. Arts[1], Marc J. Gunter[6], Michael F. Lei[7]

[1]Maastricht University, [2]VieCuri Medical Center, [3]Zuyderland Medical Center, [4] International Agency for Research on Cancer (IARC), [5]Imperial College, London, [6]International Agency for Research, [7]University of Regensburg

2-56 Sedentary behaviour peaks at 4-5 years of age in a longitudinal, population-based study of children with cerebral palsy followed between 1.5 and 12 years

Sjaan Gomersall[1], Emily Johnson[1], Sarah Reedman[1], Stewart Trost[2], Leanne Sakzewski[1], Roslyn Boyd[1]

[1]The University of Queensland, [2]Queensland University of Technology

2-58 Physical activity and sleep patterns in pediatric rehabilitation.

Mattiènne van der Kamp[1], Miriam Cabrita[1], Allard Dijkstra[2], Monique Tabak[1]

[1]Roessingh Research and Development / University of Twente, [2]Roessingh Centre of Rehabilitation

2-60 Stepping behavior compensation after 12 weeks of exercise training in de novo Parkinson's disease:Effects of intensity

Jennifer Blankenship[1], Corey Christiansen[1], Charity Patterson[2], Margaret Schenkman[1], Edward Melanson[1]

[1]University of Colorado Anschutz Medical Campus, [2]University of Pittsburgh

2-62 Accelerometer-measured physical activity during school day - different methods for the segmentation of lesson time and recess time

Janne Kulmala[1], Harto Hakonen[1], Jouni Kallio[1], Tammelin Tuija[1]

[1]LIKES Research Centre for Physical Activity and Health

2-64 Self-assessment of outdoor walking using a sports watch

Rolf Moe-Nilssen[1], Jorunn Helbostad[2]

[1]University of Bergen, [2]Norwegian University of Science and Technology

Poster Session 3

THURSDAY, JUNE 27
12:30 – 13:15

3-01 Social disengagement level is associated with time spent supine during the day in older adults

Jeffrey Hausdorff[1], Irina Galperin[1], Inbar Hillel[1], Topaz Sharon[2], Ilan Kurz[1], Anat Mirelman[1]

[1]Tel Aviv Sourasky Medical Center, [2]Tel Aviv University

3-03 Tri-axial thigh-worn accelerometers for 24-hour monitoring of physical behaviour in adults: A systematic scoping review

Matthew Stevens[1], Elif Eroglu[2], Nidhi Gupta[3], Patrick Crowley[1], Andreas Holtermann[1], Emmanuel Stamatakis[2]

[1]National Research Center for the Work Environment/Aalborg University, [2]University of Sydney, [3]The National Research Centre for the Working Environment

3-05 Thigh accelerometry: Measured walking cadence at work and leisure

Charlotte Lund Rasmussen[1], Nidhi Gupta[2], Patrick Joseph Crowley[1], Emmanuel Stamatakis[3], Andreas Holtermann[4]

[1]National Research Centre for the Working Environment, [2]The National Research Centre for the Working Environment, [3]University of Sydney, [4]National Research Center for the Work Environment/Aalborg University

3-07 Converting raw accelerometer data to activity counts using open source code in MATLAB, Python, and R – A comparison to ActiLife activity counts

Ruben Brondeel[1], Yan Kestens[2], Meghan Winters[3], Javad Rahimipour Anaraki[4], Kevin Stanley[5], Benoit Thierry[2], Daniel Fuller[4]

[1]Ghent University, [2]University of Montreal, [3]Simon Fraser University, [4]Memorial University of Newfoundland, [5]University of Saskatchewan

3-09 Application of a shallow convolutional neural network for activity recognition from leg-instrumented wearable sensors

Riley Bloomfield[1], Kenneth McIsaac[1], Matthew Teeter[1]

[1]Western University

3-11 Eye movement classification with EOG and motion sensors in instrumented eyewear

Jose Francisco Pedrero Sánchez[1], Helios De Rosario Martínez[1], Úrsula Martínez Iranzo[1]

[1]Universitat Politécnica de Valéncia

3-12 Obtaining the vertical displacement of the center of masses during the sit to stand test using accelerometers integrated in a Rapsberry Pi

Jose Francisco Pedrero Sánchez[1], Juan-Manuel Belda-Lois[1]

[1]Universitat Politécnica de Valéncia

3-13 Accelerometry frequency filtering in free-living physical activity measurement

Jonatan Fridolfsson[1], Mats Börjesson[1], Lauren Lissner[1], Monica Hunsberger[1], Örjan Ekblom[2], Elin Ekblom-Bak[2], Christoph Buck[3], Daniel Arvidsson[1]

[1]University of Gothenburg, [2]The Swedish School of Sport and Health Sciences, [3]Leibniz Institute for Prevention Research and epidemiology

POSTER SESSIONS

3-15 Modeling agreement for binary intensive longitudinal data: validation of the MOX® in patients with chronic organ failure

Sophie Vanbelle[1], Emmanuel Lesaffre[2]

[1]Maastricht University, [2]KU Leuven

3-17 Volume and pattern of free-living physical behaviour long time post-stroke

Malcolm Granat[1], Mona Aaslund, Bente Gjelsvik[1], Bard Bogen[1], Rolf Moe-Nilssen[1], Halvor Næss[1], Håkon Hofstad[1], Jan Skouen[1]

[1]University of Salford

3-19 Concurrent validity and reliability of a field measure for peak whole-body power during sit-to-stand transfer in older adults

Mirjam Pijnappels[1], Lianne van Horen[1], Sjoerd Bruijn[1], Karin Gerrits[1]

[1]Vrije Universiteit Amsterdam

3-21 Robust and reliable gait recognition in neurological clinical practice

Heinz-Josef Eikerling[1], Michael Uelschen[1], Erik Prinsen[2], Leendert Schaake[2], Jaap Buurke[2]

[1]University of Applied Sciences, [2]Roessingh Research and Development

3-23 Validation of move-4 accelerometer for the assessment of physical behavior

Marco Giurgiu[1], Ulrich Ebner-Priemer[2], Johannes Bussmann[3], Markus Reichert[4]

[1]Karlsruhe Institute of Technology (KIT), [2]Department of Sports and Sports Science, Karlsruhe Institute of Technology (KIT), [3]Erasmus MC University Medical Center, [4]Heidelberg University

3-25 Effects on physical activity duration with a digital behavior change tool

Anna Åkerberg[1], Jan Arwald[2]

[1]Mälardalen University, [2]Delphie LST AB

3-27 Objective angle measurement on cervical vertebrae based on a gyroscope

Yolanda López-Muñoz[1], Luis Rosas[1], Laura Castellano-Torres[1], Mayra Cuéllar-Cruz[1], Arturo Vega-González[1]

[1]Universidad de Guanajuato

3-29 ActiGraph? GT3X+ & wGT3X-BT: Measurement Agreement and the influence on classification of physical activity

Simon Kolb[1], Doris Oriwol[1], Alexander Burchartz[1], Bastian Anedda[2], Steffen Schmidt[1], Alexander Woll[1]

[1]Karlsruher Institute of Technology (KIT), [2]Institute of Sports and Sportscience (IfSS)

3-30 Activity recognition and energy expenditure accuracy differences according to the number of accelerometer devices and body placement

Mamoun Mardini[1], Anis Davoudi[1], Parisa Rashidi[1], Sanjay Ranka[1], Todd Manini[1]

[1]University of Florida

3-31 Cleaning, evaluating, and scoring actigraphy data: There has to be a better way

Heather Pauls[1], Heather Pauls[1], Alana Steffen[1], Mary Hannan[1], Ulf Bronas[1]

[1]University of Illinois at Chicago

3-33 Using Recurrence Quantification Analysis to translate lab-based studies into free-living domains in wrist-worn accelerometry.

Joshua Twaites[1], Melvyn Hillsdon[1], Richard Everson[1], Joss Langford[2]

[1]University of Exeter, [2]Activinsights ltd

3-35 Comparison of sensing systems and walking tasks for classification of parkinson's diseases using gait

Rana Zia UR Rehman[1], Silvia Del Din[1], YU Guan[1], Jian Qing Shi[1], Lynn Rochester[2]

[1]Newcastle University, [2]Newcastle University Institute for Ageing

3-37 Validity evidences of ecological momentary assessment to measure participating in physical activity and sedentary behavior

Ji-Yeob Choi[1], Song Hyun Im[2], JooYong Park[1], Jaesung Choi[1], Miyoung Lee[3]

[1]Seoul National University, [2]Dongguk University, [3]Kookmin University

3-39 Single vs multiple-answer questions to assess travel school mode among children: How much information is being lost?

Damian Chandia-Poblete[1], Nicolas Aguilar-Farias[1]

[1]Universidad de La Frontera

3-41 Direct observation of attentiveness and fidgeting while using a stand-biased desk in elementary school children

Ann Swartz[1], Nathan Tokarek[1], Krista Lisdahl[1], Scott Strath[1], Chi Cho[1]

[1]University of Wisconsin-Milwaukee

3-43 Examining the relationship between objectively measured human and dog activity

Greg Petrucci Jr.[1], Robert Marcotte[1], Caitlin Rajala[2], Connor Saleeba[2], Katie Potter[2]

[1]University of Massachusetts Amherst, [2]University of Massachusetts

3-45 What about a bout? Daily stepping behavior of healthy middle to older aged adults

Kate Lyden[1], David Loudon[2], Malcolm Granat[3]

[1]KAL Research & Consulting, [2]PAL Technologies Ltd, [3]University of Salford

3-47 Prolonged sedentary pattern variables derived via activPAL versus ActiGraph cut points in children

Jordan Carlson[1], John Bellettiere[2], Simone Verswijveren[3], Jacqueline Kerr[2], Anna Timperio[4], Jo Salmon[4], Nicola Ridgers[4]

[1]Children's Mercy Kansas City, [2]University of California San Diego, [3]Deakin University, [4]Institute for Physical Activity and Nutrition (IPAN)

3-49 Children's physical activity in parks: Use of accelerometer to assess park use in low-income and racial/ethnic diverse communities in New York City

Claudia Alberico[1], Myron Floyd[1], Oriol Marquet[2], Jing-Huei Huang[1], Elizabeth Mazak[1], J. Aaron Hipp[1]

[1]North Carolina State University, [2]Instituto de Salud Global de Barcelona

3-51 Comparison of StepWatch and ActiGraph wGT3X+ step counts under treadmill walking, outdoor level walking, and daily living conditions in patients with symptomatic peripheral artery disease

Pierre-Yves de Müllenheim[1], Ségolène Chaudru[2], Guillaume Mahé[2], Alexis Le Faucheur[3]

[1]IFEPSA, [2]University Hospital of Rennes, [3]Ecole normale supérieure de Rennes

3-53 Associations between physical activity and sleep among 75+ community-dwelling Danish older adults

Li-Tang Tsai[1], Eleanor Boyle[1], Jan Brønd[1], Gry Kock[1], Fabio D'Oriente[2], Andrea Gigliotti[2], Paolo Caserotti[1]

[1]University of Southern Denmark, [2]Foro Italico University of Rome

3-55 Prediction of total energy expenditure and physical activity level using a triaxial accelerometer with a classification algorithm of ambulatory and non-ambulatory activities

Shigeho Tanaka[1], Kazuko Ishikawa-Takata[1], Satoshi Nakae[2], Satoshi Sasaki[3]

[1]National Institutes of Biomedical Innovation, Health and Nutrition, [2]Osaka University, [3]The University of Tokyo

3-57 Physical behaviours and chronotype in people with type 2 diabetes

Charlotte Edwardson[1], Alex Rowlands[1], Emer Brady[1], Andrew Hall[2], Tom Yates[1], Melanie Davies[1]

[1]University of Leicester, [2]University Hospitals of Leicester

3-59 Association between physical activity and fitness in 5 to 11 years school children

Alicia Del Saz Lara[1], Carlos Pascual Morena[1], Rubén Fernández Rodríguez[1], Irene Sequí Domínguez[1], Vicente Martínez Vizcaino[2], Alba Soriano Cano[2], Montserrat Hernández Luengo[2], María Eugenia Visier Alfonso[2], Andrés Redondo Tebar[2]

[1]Universidad de Castilla - La Mancha, [2]Centro De Estudios Sociosanitarios (Cess)

3-61 The physiological demands of cycling on an electrically supported tricycle

Roos Bulthuis[1], Monique Tabak[1]

[1]Roessingh Research & Development

3-63 Differences in total activity and activity intensity proportions across levels of physical functionality

Andrew Kaplan[1], Taylor Rowley[1], Ann Swartz[1], Allison Hyngstrom[2], Kevin Keenan[1], John Staudenmayer[3], Scott Stath[1]

[1]University of Wisconsin- Milwaukee, [2]Marquette University, [3]University of Massachusetts Amherst

Poster Session 4

THURSDAY, JUNE 27

13:15 – 14:00

4-02 Cross-sectional associations between sleep duration, sedentary time, physical activity, and obesity among Czech school-aged children using compositional analyses: Preliminary results.

Jan Dygrýn[1], Ales Gába[1], Lukás Rubín[1], Lukás Jakubec[1], Karel Hron[1]

[1]Palacký University Olomouc

4-04 Semi-automatic processing of manual entries in the online 24-hour time use survey of the German National Cohort

Andrea Hillreiner[1], Maximilian Ott[1], Beate Fischer[1], Michael Leitzmann[1]

[1]University of Regensburg, Department of Epidemiology and Preventive Medicine

4-06 Compositional relationships between movement behaviours with cognitive and motor development in preschool-aged children

Nicholas Kuzik[1], Nicholas Kuzik[1], Valerie Carson[1]

[1]University of Alberta

4-08 Estimation of metabolic equivalent values of daily activities using heart rate monitor and anthropometry measures

Yuko Caballero[1], Takafumi Ando[2], Satoshi Nakae[3], Chiyoko Usui[4], Tomoko Aoyama[2], Motofumi Nakanishi , Sho Nagayoshi , Yoko Fujiwara[1], Shigeho Tanaka

[1]Ochanomizu Graduate University, [2]National Institute of Health and Nutrition, [3]Osaka University, [4]Waseda University, Omron Healthcare Co., Ltd., National Institutes of Biomedical Innovation, Health and Nutrition

4-10 Travel choices: Identifying periods of seated car travel using an accelerometer

Craig Speirs[1], David Loudon[1], Douglas Maxwell[1], Kate Lyden[2], Sarah Keadle[3], Rachel Barnett[4], Julian Martinez

[1]PAL Technologies Ltd, [2]KAL Research & Consulting, [3]California Polytechnic State University San Luis Obispo, [4]California Polytechnic State University, University of Wisconsin - Milwaukee

4-14 Validity of harmonised self-reported physical behaviours in UK Biobank: A doubly labelled water study

Matthew Pearce[1], Youngwon Kim[2], Tessa Strain[1], Kate Westgate[1], Nick Wareham[1], Søren Brage[3]

[1]MRC Epidemiology Unit, [2]Hong Kong University, [3]University of Cambridge

4-16 Quantity and quality of ambulatory activity in people with Parkinson's disease and healthy controls

Vrutangkumar Shah[1], James McNames[2], Carolin Curtze[3], Martina Mancini[1], Patricia Carlson-Kuhta[1], John Nutt[1], Mahmoud El Gohary[1], Fay Horak[1]

[1]Oregon Health and Science University, [2]PSU, [3]University of Nebraska Omaha

4-18 Device assessed physical activity in a clinical trial of participants with malignant pleural effusion: a sub-study of the Australasian Malignant PLeural Effusion (AMPLE)-2 randomized trial.

Carolyn McIntyre[1], Sanjeevan Muruganandan[2], McVeigh Joanne[3], Deirdre Fitzgerald[4], Maree Azzopardi[4], Rajesh Thomas[4], Cathy Read[4], Leon Straker[3], Robert Newton[1], Kevin Murray , Lee Gary[4]

[1]Edith Cowan University, [2]The Northern Health, [3]Curtin University, [4]Sir Charles Gairdner Hospital, University of Western Australia

4-20 It's your turn: The measurement of turning in free-living stepping

Nicholas Smith[1], Nikos Mourselas[1]

[1]PAL Technologies Ltd

4-22 Signatures of knee osteoarthritis in the temporal and fractal dynamics of human gait

Loek Verlaan[1], Joris Vangeneugden[1], Pieter Oomen[1], Waiyan Liu[1], Marloes Peeters[1], Nicole Natour[1], Pieter Emans[1], Kenneth Meijer[2]

[1]MUMC+, [2]Maastricht University Medical Centre+

4-24 Effect of increased physical activity with novel technology to reduce weight in subjects with metabolic syndrome.

Irene Sequí Domínguez[1], Carlos Pascual Morena[1], Rubén Fernández Rodríguez[1], Alicia Del Saz Lara[1], Diana Pozuelo-Carrascosa[2], Jorge Cañete García-Prieto[2], Estela Jiménez-López[2], Montserrat Solera-Martínez[2], Abel Ruiz-Hermosa[2]

[1]Universidad de Castilla - La Mancha, [2]Universidad de Castilla-La Mancha

4-26 People with low cardiorespiratory fitness are physically the most active with relation to their individual fitness

Henri Vähä-Ypyä[1], Harri Sievänen[1], Ari Mänttäri[2], Pauliina Husu[1], Kari Tokola[1], Jaana Suni[1], Tommi Vasankari[1]

[1]The UKK Institute for Health Promotion Research, [2]UKK Institute

4-28 Defining accelerometer thresholds for the activPAL3 micro in an adolescent population

Grainne Hayes[1], Kieran Dowd[2], Ciaran MacDonncha[1], Alan Donnelly[1]

[1]University of Limerick, [2]Athlone Institute of Technology

4-34 Capturing accelerometer outputs in healthy volunteers under normal and simulated-pathological conditions

Valeria Filippou[1], Anthony Redmond[2], Michael Backhouse[3], David Wong[4]

[1]University of Leeds, [2]NIHR Leeds BRC, Chapel Allerton Hospital, [3]York Trials Unit | Department of Health Sciences, [4]Leeds Institute for Data Analytics

4-36 Momentary fatigue negatively affects daily step count and maximum walking speed in healthy older adults

Tomas Vetrovsky[1], Dan Omcirk[1], Jan Malecek[1], Petr Stastny[1], Michal Steffl[1], James Tufano[1]

[1]Charles University

4-38 Exploration of spatiotemporal variation in preschooler's schoolyard physical activity

Kimberly Clevenger[1], Sue Grady[1], Karl Erickson[1], James Pivarnik[1], Karin Pfeiffer[1]

[1]Michigan State University

4-40 Apples to apples? A comparison of existing data processing and reduction protocols on accelerometer metrics in children with type 1 diabetes mellitus

Joyce Obeid[1], Sara King-Dowling[1], Brian Timmons[1]

[1]Child Health & Exercise Medicine Program, McMaster University

4-44 Comparison of two objective measures of children's classroom postural behaviors

Nathan Tokarek[1], Chi Cho[1], Scott Strath[1], Ann Swartz[1]

[1]University of Wisconsin - Milwaukee

4-46 Cohort profile: the Australian Breakthrough Cancer (ABC) Accelerometer Sub-Study

Nga Nguyen[1], Brigid Lynch[1], Emily Avice[1], Theresa Whalen[1], Fiona Bruinsma[1], Graham Giles[1], Roger Milne[1]

[1]Cancer Council Victoria

4-48 Towards improved physical activity monitoring: Collecting physical activity and sedentary behaviour data in Dutch adults using commonly-used questionnaires as well as an accelerometer

Ellen de Hollander[1], Anne Loyen[1], Marjolein Duijvestijn[1], Wanda Vos[1]

[1]National Institute for Public Health and the Environment

4-50 On placement, location and orientation of wrist-worn tri-axial accelerometers during free-living measurements

Marcin Straczkiewicz[1], Nancy Glynn[2], Tamara Harris[3], Jaroslaw Harezlak[4]

[1]Department of Epidemiology and Biostatistics, School of Public Health, Indiana University-Bloomington, [2]University of Pittsburgh, [3]Laboratory of Epidemiology, Demography, and Biometry, National Institute on Aging, [4]Indiana University

4-52 The associations between nighttime sleep and physical activity intensities in preschool-aged children

Becky Breau[1], Hannah Coyle-Asbil[1], Jess Haines[1], David Ma[1], Lori Ann Vallis[1]

[1]University of Guelph

4-54 An insulin-delivery closed-loop system for people with Type 1 diabetes (artificial pancreas) : Performances with physical activity announcement

Maeva Doron[1], Gaëlle Ardito[1], Emma Villeneuve[1], Romain Blanc[1], Héctor Romero Ugalde[1], Guillaume Charpentier[2], Pierre-Yves Benhamou[3], Erik Huneker[4], Sylvia Franc[2], Chantal Simon[5]

[1]Univ. Grenoble Alpes, CEA, LETI, F-38000 Grenoble., [2]CERITD, [3]Univ. Grenoble Alpes, CHU Grenoble Alpes, Endocrinology, CS10217, 38043 Grenoble, France, [4]Diabeloop SA, [5]Carmen Inserm U1060/Université de Lyon 1/INRA U1235, CRNH-Rhône-Alpes, Lyon, France.

4-56 Accelerometer-measured physical activity of 5-year-old children: Comparing the amount of light and moderate to vigorous intensity physical activity using different ActiGraph cut points

Tuija Tammelin[1], Janne Kulmala[1], Harto Hakonen[1], Jouni Kallio[1], Beata Stach-Lempinen[2], Elina Engberg[3], Saila Koivusalo[1]

[1]LIKES Research Centre for Physical Activity and Health, [2]South Karelia Social and Health Care District, [3]Folkhälsan Research Center

4-58 Determination of moderate-intensity physical activity for older people with impaired mobility

Casey Peiris[1], Nicholas Taylor[1]

[1]La Trobe University

4-60 Sex and age differences in device-measured sedentary behavior and physical activity in community dwelling older adults

Ing-Mari Dohrn[1], Elisabeth Winkler[2], Anna-Karin Welmer[1]

[1]Karolinska Institutet, [2]University of Queensland

4-62 Posture and activity classification in non-ambulant children and adolescents with Cerebral Palsy

Matthew Ahmadi[1], Benjamin Goodlich[2], Ellen Armstrong[2], Sean Horan[2], Chris Carty[2], Emmah Baque[2], Stewart Trost[1]

[1]Queensland University of Technology, [2]Griffith University

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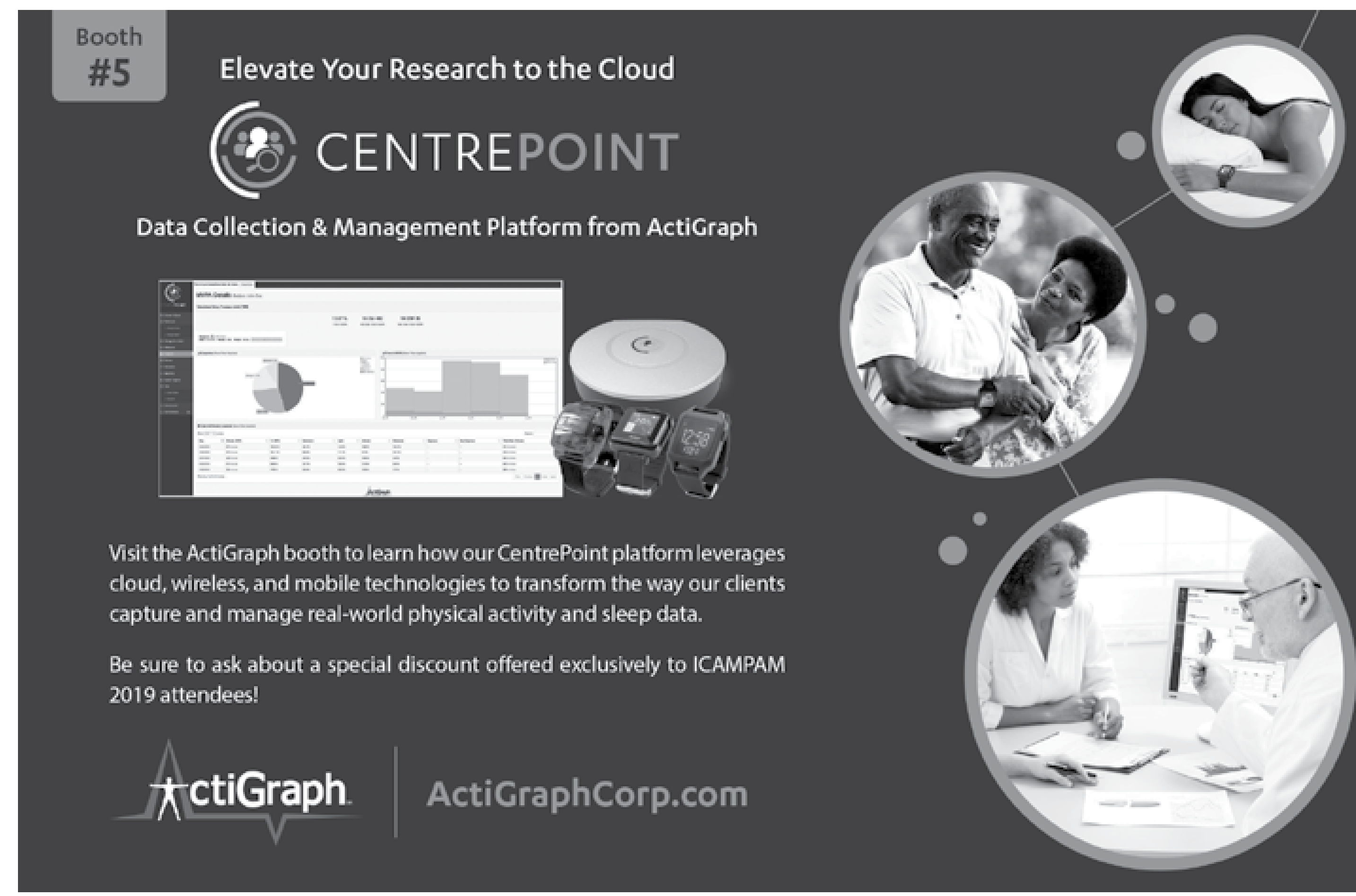
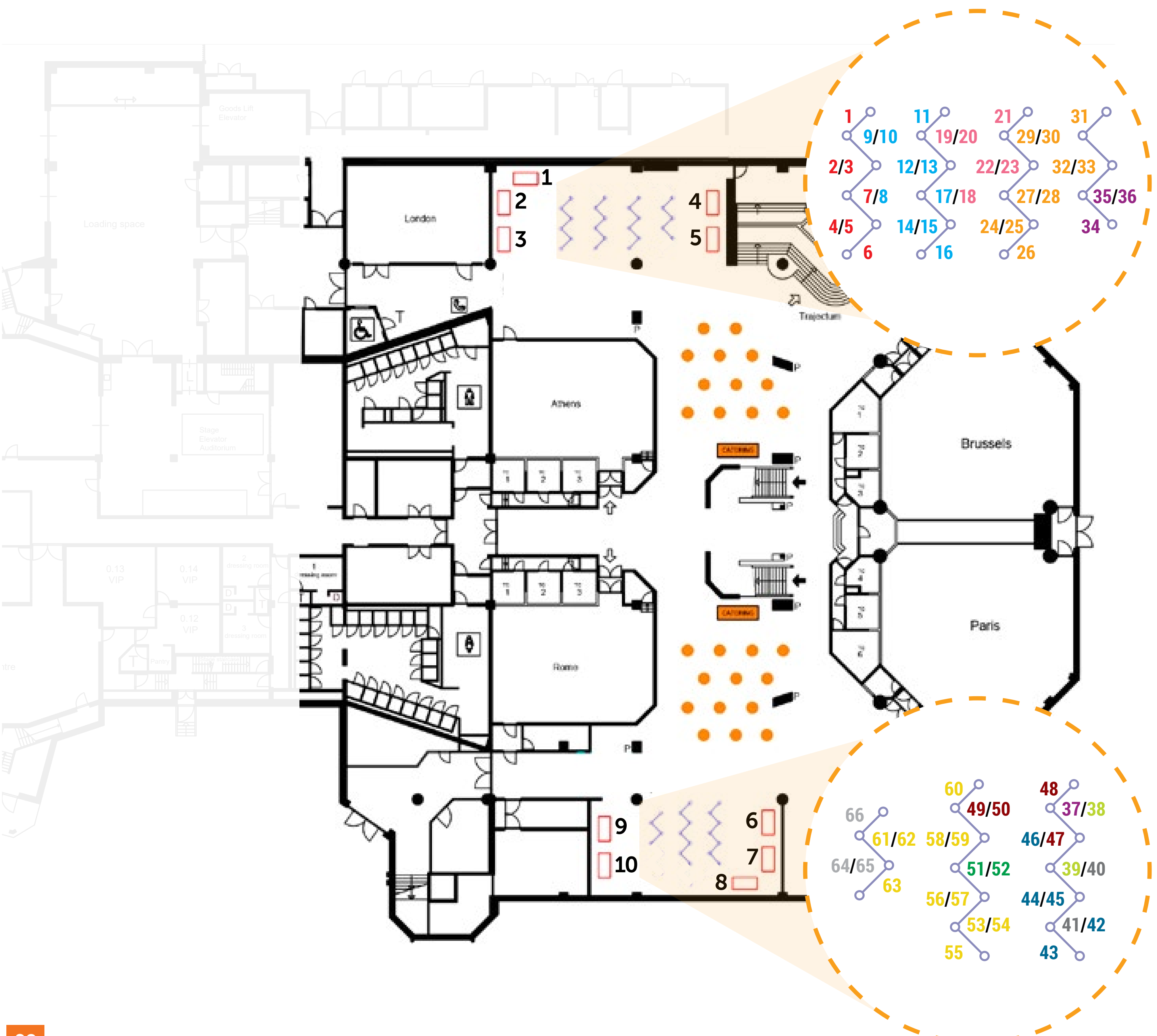


POSTER AND EXHIBITOR FLOOR PLAN

POSTER SESSIONS 1 & 2

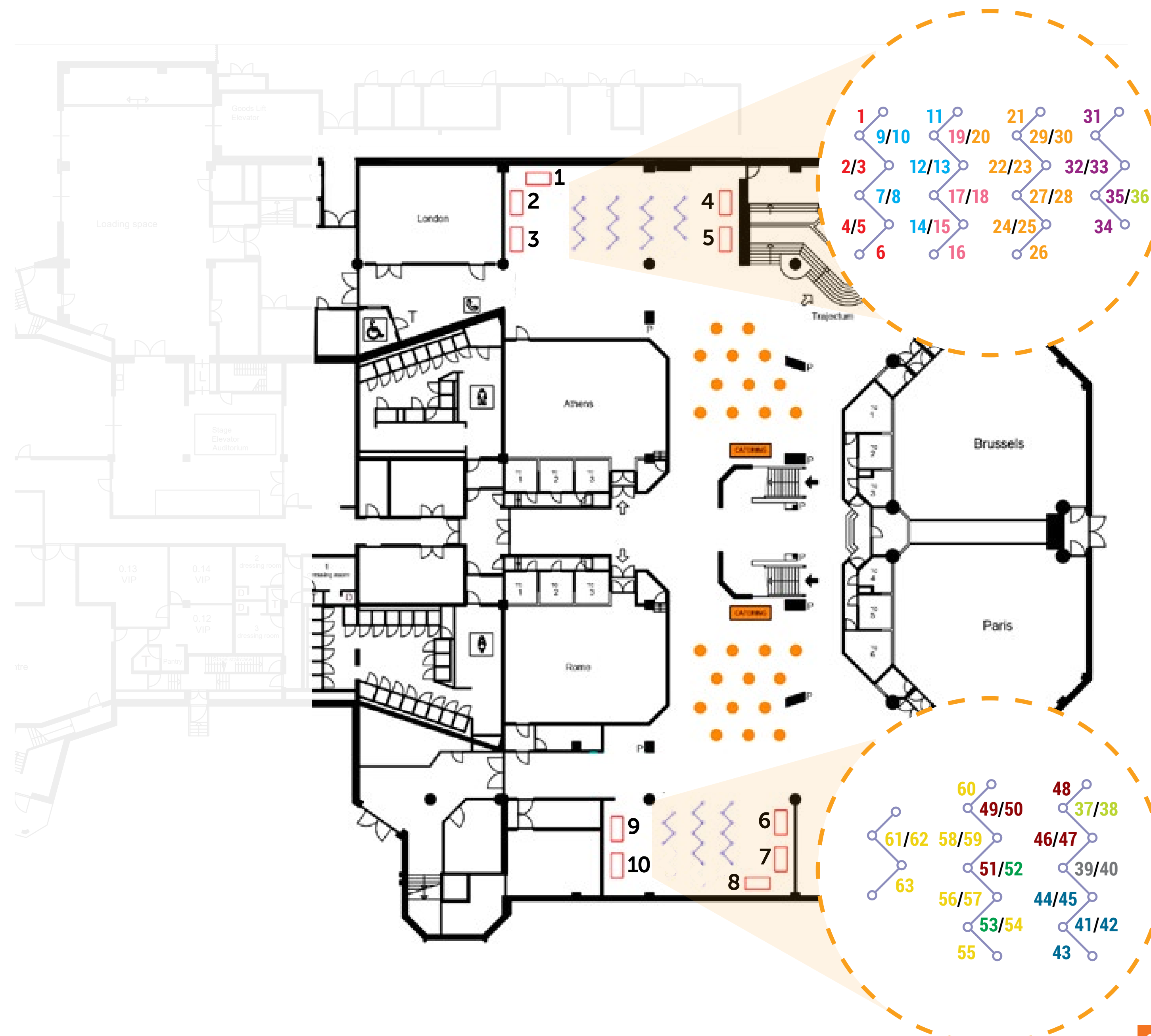
A	24-hour activity cycle	1 – 7
B	Algorithm development	8 – 17
C	Clinical applications	18 – 22
D	Device development and validation	24 – 32
E	Machine learning and data science approaches	34 – 37
F	Multimodal assessment	38 – 39
G	Performance analysis	40 – 41
H	Real-world applications (site specific)	42 – 46
I	Research devices	47 – 50
J	Sleep research	51 – 52
K	Special populations	53 – 63
L	Use of consumer devices in research	64 – 65



POSTER AND EXHIBITOR FLOOR PLAN

POSTER SESSIONS 3 & 4

A	24-hour activity cycle	1 – 6
B	Algorithm development	7 – 14
C	Clinical applications	15 – 19
D	Device development and validation	20 – 30
E	Machine learning and data science approaches	31 – 35
F	Multimodal assessment	36 – 38
G	Performance analysis	39 – 40
H	Real-world applications (site specific)	41 – 45
I	Research devices	46 – 51
J	Sleep research	52 – 53
K	Special populations	54 – 63



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