IEEE Biomedical and Health Informatics (BHI) and the Body Sensor Networks (BSN) Conferences EMB

BHI & BSN 2018

4-7, March 2018 Treasure Island Hotel & Casino, Las Vegas, Nevada – USA

Workshop/Tutorial title:

Automatic Dietary Monitoring 2018: The grand challenge from lab to real-life systems

Organizers

Oliver Amft, Friedrich Alexander University Erlangen-Nürnberg (FAU)
Samantha Kleinberg, Stevens Institute of Technology
Benny Lo, Imperial College
Edison Thomaz, University of Texas Austin

Short description

Body-worn sensors promise to be sufficiently unobtrusive for everyday continuous long-term diet monitoring as well as informative for sustainable diet change. Investigations on body-worn sensors and related analysis algorithms to monitor dietary behavior have gained wide interest in the BSN community. Still, unobtrusive monitoring and intervention systems for diet management are hard to realise. Technology must be ready for real-life everyday monitoring of relevant behavioral aspects related to food intake.

Contents

- Intake detection and pattern analysis algorithms based on on-body sensor data, e.g. timing, food type, amount, and calories
- Studies on and methodologies for technology-supported situative dietary coaching and guidance on lifestyle changes
- Trustworthy evaluation methodologies for free-living performance
- Recent developments in smart garments and smart accessories that promise substantial progress for ADM
- Opinions of dietician and coaches on technology requirements
- Presentations of relevant datasets available to other researchers

CVs of the organizers

Oliver Amft is a professor and founding director of the Chair of eHealth and mHealth at FAU Erlangen-Nürnberg, interested in context recognition, and health wearables.
Samantha Kleinberg is an Assistant Professor at Stevens Institute of Technology and author of 'Causality, Probability, and Time' and 'Why: A Guide to Finding and Using Causes'.
Benny Lo, PhD., is a Senior Lecturer of the Hamlyn Centre at Imperial College London, interested in Body Sensor Networks (BSN), Machine Learning, and Microelectronics.
Edison Thomaz is a Research Assistant Professor at The University of Texas at Austin, developing systems for sensing, recognizing and modeling everyday activities and context.




Automatic Dietary Monitoring 2018
The grand challenge from lab to real-life systems

Sunday, March 4th, 2018 @ 8:30am-1:30pm, Treasure Island Hotel&Casino, Las Vegas, USA
In conjunction with the
International Conference on Wearable and Implantable Body Sensor Networks (BSN 2018)

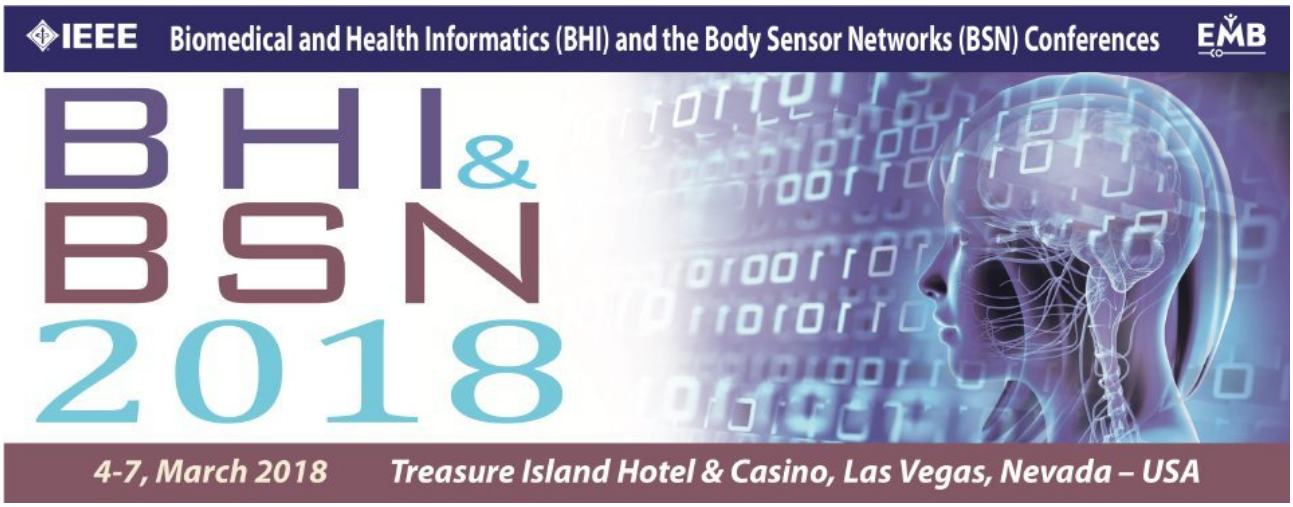
Body-worn sensors promise to be sufficiently unobtrusive for everyday continuous long-term diet monitoring as well as informative for sustainable diet change. Investigations on body-worn sensors and related analysis algorithms to monitor dietary behaviour have gained wide interest in the BSN community. Still, unobtrusive monitoring and intervention systems for diet management are hard to realise. Technology must be ready for real-life everyday monitoring of relevant behavioural aspects related to food intake. The Automatic Dietary Monitoring workshop invites innovative scientific contributions on the following non-exhaustive list of topics:

- Intake detection and pattern analysis algorithms (online and offline) involving on-body sensor data, including timing, food type, amount, and calories.
- Studies on and methodologies for technology-supported situative dietary coaching and guidance on the lifestyle changes.
- Trustworthy evaluation methodologies, in particular those that generalise onto free-living performance.
- Recent developments in smart garments and smart accessories that promise substantial progress for ADM.
- Opinions of dietician and coaches on supportive technology and requirements.
- Presentations of relevant datasets available to other researchers.

ADM 2018 will bring together researchers and students actively developing automatic dietary monitoring systems, practitioners, clinicians, and coaches requiring monitoring systems, and everyone interested in the area of dietary monitoring. The workshop will feature technical and medical/coaching presentations. In addition, posters and a plenary discussion will make ADM 2018 an exciting event.

Organizers

Oliver Amft, Friedrich Alexander University Erlangen-Nürnberg (FAU)
Samantha Kleinberg, Stevens Institute of Technology
Benny Lo, Imperial College London
Edison Thomaz, University of Texas at Austin



Automatic Dietary Monitoring 2018
The grand challenge from lab to real-life systems

Sunday, March 4th, 2018 @ 8:30am-1:30pm, Treasure Island Hotel&Casino, Las Vegas, USA
Room: Treasure Island E

Agenda

8:20am – 8:30am	Welcome and introduction	Organizers
8:30am – 8:55am	Rethinking Sensor-based Dietary Monitoring. Are we moving the needle for clinically relevant applications?	Temiloluwa Prioleau, Rice University
8:55am – 9:20am	Diet monitoring in unconstrained environments	Abdelkareem Bedri, CMU
9:20am – 9:45am	Tracking Wrist Motion During Free Living to Detect and Measure Energy Intake	Adam Hoover, Clemson University
9:45am – 10:10am	Eating Detection with Wrist-Mounted Sensors: Challenges, Lessons Learned and Next Steps	Edison Thomaz, University of Texas at Austin
10:10am – 10:30am	Break & Poster session	
10:30am – 10:55am	Top-down and bottom-up eating timing spotting in free-living using smart eyeglasses	Rui Zhang, FAU Erlangen-Nürnberg
10:55am – 11:20am	Auracle: a wearable device for detecting and monitoring eating behavior	David Kotz, Dartmouth College
11:20am – 11:45am	Multimodality Monitoring for Estimating Food Type in Daily Life	Samantha Kleinberg, Stevens Institute of Technology
11:45am – 12:00pm	Short break	
12:00pm – 12:25pm	Wearable devices for monitoring dietary intake across the globe	Megan McCroy, Boston University
12:25pm – 12:50pm	Food detection in egocentric images using artificial intelligence technology	Wenyan Jia, University of Pittsburgh
12:50am – 1:10pm	Plenary discussion & planning	Organizers
1:10pm – 1:15pm	Conclusion	Organizers

Talks: 20 min +5 min Q&A

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Top-down and bottom-up eating timing spotting in free-living using smart eyeglasses

Rui Zhang, PhD candidate, Chair of eHealth and mHealth, Friedrich-Alexander University (FAU) of Erlangen-Nürnberg

Abstract

Eating spotting can be performed by using top-down or bottom-up approaches. In the top-down approach, sensor data are used directly to recognised eating events. If necessary, individual eating patterns, e.g. chewing cycles, and intake gestures could be derived using the recognised eating events. In the bottom-up approach, individual eating patterns are first modelled, and the result is used to derive eating events subsequently. In this talk, I will introduce two eating spotting implementations using the top-down and bottom-up methods respectively. The methods were evaluated with EMG data recorded using personalised dietary monitoring eyeglasses in a free-living study. The results of eating spotting performance and timing errors might shed some light into the comparison and selection of the two approaches for future works.

Short bio

Rui Zhang is currently working as a Ph.D. candidate at the Chair of eHealth and mHealth in Friedrich-Alexander University (FAU) of Erlangen-Nürnberg, Germany. In 2015, he received the M.Sc. degree in the filed of Medical Systems Engineering from Otto-von-Guericke University (OvGU) of Magdeburg, Germany. In 2012, he received the B.Sc. degree in the field of Automation in Nanjing University of Science and Technology (NJUST), China. His research focus is Automatic Dietary Monitoring techniques using wearables.

Rethinking Sensor-based Dietary Monitoring. Are we moving the needle for clinically relevant applications?

Temiloluwa Prioleau, Ph.D., Electrical & Computer Engineering,
Rice University

Abstract

The vision of this talk is to prompt an open discussion about what has been done so far and whether or not engineering solutions are moving toward meeting the clinical needs. If not, how can we redirect some of the research toward clinically relevant needs for dietary monitoring.

Short bio

Temiloluwa Prioleau, Ph.D., is a postdoctoral fellow in the Electrical and Computer Engineering department at Rice University. Her primary research agenda aims to leverage mobile/wearable systems and novel data analysis methods to inform personalized health interventions and improved health decisions. Dr. Prioleau received her bachelor's degree from the University of Texas at Austin and her Ph.D. from Georgia Institute of Technology, all in Electrical Engineering. Her Ph.D. and continued post-doctoral research has focused on "Sensor-based Dietary Monitoring" with a more recent vision of evaluating approaches that have the high potential for clinical translation.

Wearable devices for monitoring dietary intake across the globe

Megan McCrory, Ph.D., Boston University

Abstract

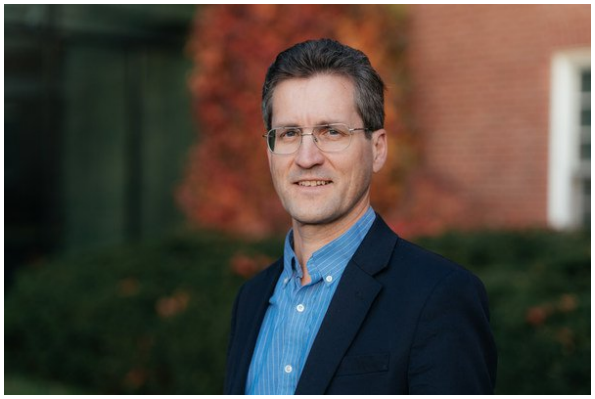
For many years, the mainstays of dietary intake assessment methods have included weighed and estimated food intake records, dietary recalls, and questionnaires. However, all of these methods rely on self-report, and hence can result in underestimation of caloric intake. In addition, they can be burdensome for individuals to carry out. More recently, technology has been harnessed to develop newer methods which can overcome many of the limitations of self-reported intake. In this presentation, Dr McCrory will discuss her collaborative work on one of these newer methods, the Automatic Ingestion Monitor (AIM), a wearable device that senses chews and swallows. She will also present a newly funded project that she and her colleagues are undertaking to adapt wearable technology to assess diet in low income countries.

Short bio

Dr McCrory is a Research Associate Professor of Nutrition in the Department of Health Sciences at Boston University. She holds bachelors and master's degrees in Exercise Science and a PhD in Nutrition from the University of California at Davis. She also completed postdoctoral training in the Energy Metabolism Laboratory at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University. Dr McCrory studies eating patterns such as snacking, eating frequency, meal skipping and timing, dietary variety, taste preferences, and eating food prepared away from home, and their interactions with dietary composition factors such as macronutrients and fiber, and their effects on energy balance and appetite. She is an expert in various methods of dietary assessment, with much of her research focused on improving the measurement of dietary intake. For several years, her work has been successfully funded by NIH, and most recently she was also awarded a grant by The Bill and Melinda Gates Foundation as part of the investigative team to develop an in innovative dietary monitoring system for use in low income countries. Dr McCrory was named an International Life Sciences Institute (ILSI) Future Leader in nutrition in 2003 and currently serves on the Editorial Boards of the scientific journals Advances in Nutrition and Frontiers in Nutrition.

Auracle: a wearable device for detecting and monitoring eating behavior

David Kotz, Ph.D, Professor, Department of Computer Science, Dartmouth College



Abstract

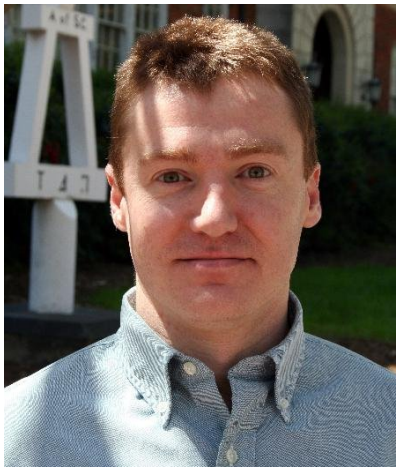
Researchers strive to understand eating behavior as a means to develop diets and interventions that can help people achieve and maintain a healthy weight, recover from eating disorders, or manage their diet and nutrition for personal wellness. A major challenge for eating-behavior research is to understand when, where, what, and how people eat. In this paper, we evaluate sensors and algorithms designed to detect eating activities, more specifically, *when* people eat. We compare two popular methods for eating recognition (based on acoustic and electromyography (EMG) sensors) individually and combined. We built a data-acquisition system using two off-the-shelf sensors and conducted a study with 20 participants. Our preliminary results show that the system we implemented can detect eating with an accuracy exceeding 90.9% while the crunchiness level of food varies. We are developing a wearable system that can capture, process, and classify sensor data to detect eating in real-time.

Short bio

David Kotz is serving as the Interim Provost at Dartmouth College through June 2018. He is also the Champion International Professor in the Department of Computer Science. He previously served as Associate Dean of the Faculty for the Sciences, as the Executive Director of the Institute for Security Technology Studies, and on the US Healthcare IT Policy Committee. His research interests include security and privacy, pervasive computing for healthcare, and wireless networks. He has published over 130 refereed journal and conference papers and obtained over $65m in grant funding. He is an IEEE Fellow, a Senior Member of the ACM, a 2008 Fulbright Fellow to India, and an elected member of Phi Beta Kappa. After receiving his A.B. in Computer Science and Physics from Dartmouth in 1986, he completed his Ph.D in Computer Science from Duke University in 1991 and returned to Dartmouth to join the faculty. For more information see http://www.cs.dartmouth.edu/~dfk/.

Tracking Wrist Motion During Free Living to Detect and Measure Energy Intake

Adam Hoover, PhD, Professor, Electrical and Computer Engineering Department, Clemson University



Abstract

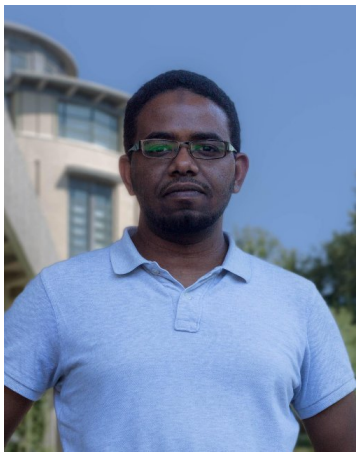
Our group is developing technologies for dietary monitoring using sensors worn on the wrist in the form of watch. The watch tracks wrist motion all day to automatically detect periods of eating. Subsequently, the watch tracks wrist motion during the eating activity to count the number of bites taken, where a bite is the action of placing food into the mouth. This talk will present the results of several studies examining the underlying biology of these processes as well as accuracies achieved in detecting eating activities and measuring energy intake.

Short bio

Adam Hoover, PhD, received a BS (1992) and MS (1993) in Computer Engineering, and a PhD (1996) in Computer Science and Engineering, all from the University of South Florida. During this time his research focused on range image processing and 3D model construction for object recognition and mobile robot navigation. From 1996-1998 he held a post-doctoral position at the University of California, San Diego, in the Electrical and Computer Engineering Department. During this time Adam Hoover's research focused on retinal image processing, and sensor network control of mobile robots. In 1999 Hoover joined the Electrical and Computer Engineering Department of Clemson University, where he is currently a Professor. His current research focuses on tracking systems. Tracking can refer to physical problems, such as locating where things are in the world, and also signal problems, such as identifying the relative health of an individual's blood pressure over time. Image and signal processing, mHealth, state space modeling, filtering, and embedded computing form the background of my work. His group works with many types of sensors, and often builds embedded systems that prototype novel tracking ideas. Adam Hoover is currently an Associate Editor for the IEEE Journal of Biomedical and Health Informatics.

Diet monitoring in unconstrained environments

Abdelkareem Bedri, Human-Computer Interaction Institute, Carnegie Mellon University



Abstract

Automatic diet monitoring involves answering questions such as what kind of food is eaten, and how much food was consumed. However, to effectively answer these questions, we first need to answer "whether the user is eating?" This question has been one of the most difficult to tackle; especially in the wild, due to the environmental noise that can disturb the signal and the wide range of activities that can be confused with eating in the free-living environment. In this talk, I present the evolution of a multi-modal eating detection system that we have developed. Considering an eating event can happen anytime during the day, we use socially-acceptable form-factors such as earbuds, eyeglasses, etc. I will also discuss our machine learning process and our novel study design that allows high-fidelity data collection in semi-controlled environments. Our approach enables us to achieve good performance in detecting eating activities in unconstrained environments.

Short bio

Abdelkareem Bedri is a second year PhD student at Carnegie Mellon University, Human-Computer Interaction Institute. He received a B.S. degree in electronics and computer engineering from University of Khartoum, an MRes degree in systems engineering from University of Reading, and an M.S. degree in computer science from Georgia Institute of Technology. Kareem’s research interests are in activity recognition, wearable computers and mobile health.

Multimodality Monitoring for Estimating Food Type in Daily Life

Samantha Kleinberg, Ph.D., Computer Science,
Stevens Institute of Technology

Abstract

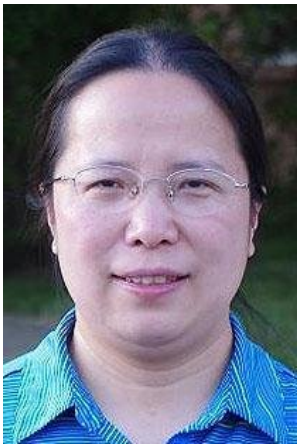
To make automated dietary monitoring useful for practical applications, it is necessary to not only estimate meal times but also foods consumed. Further, this must be done in realistic environments where there may be background noise and a variety of motion, and it must be done with realistic meals, where foods are often combined and there is an unlimited number of food types. Progress toward the goal of a estimating what, when, and how much people eat, though, may have a tremendous impact on management of health and chronic disease. In this talk I discuss my lab's work on taking dietary monitoring out of the lab and into daily life, describing progress toward recognizing both meal times and food type in unconstrained environments. Finally, I discuss challenges faced in conducting and evaluating such work, and open questions for future work.

Short bio

Samantha Kleinberg is an Assistant Professor of Computer Science at Stevens Institute of Technology. She received her PhD in Computer Science from New York University in 2010 and was a Computing Innovation Fellow at Columbia University in the Department of Biomedical informatics from 2010-2012. She is the recipient of NSF CAREER and JSMF Complex Systems Scholar Awards and is a 2016 Kavli Fellow of the National Academy of Sciences. She is the author of Causality, Probability, and Time (Cambridge University Press, 2012) and Why: A Guide to Finding and Using Causes (O'Reilly Media, 2015).

Food detection in egocentric images using artificial intelligence technology

Wenyan Jia, University of Pittsburgh



Abstract

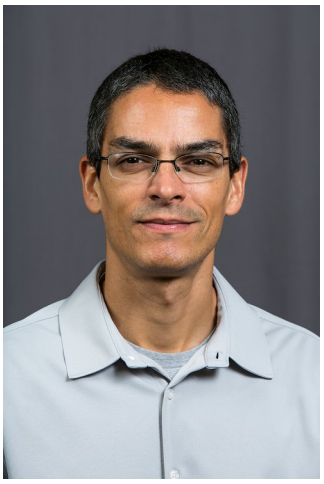
Artificial intelligence (AI) has great potential in nutrition science because it may someday conduct automatic dietary analysis. In this work we use AI to detect editable or drinkable items from images acquired by eButton, a wearable device for dietary assessment in real life. Encouraging results have been achieved with a relative high detection accuracy even for low-quality images.

Short bio

Wenyan Jia received her PhD in biomedical engineering from Tsinghua University, China, in 2005, and then joined the University of Pittsburgh in the same year. Her current research interests include biomedical signal and image processing, wearable electronic devices, and mobile health.

Eating Detection with Wrist-Mounted Sensors: Challenges, Lessons Learned and Next Steps

Edison Thomaz, Ph.D., Dept. of ECE and School of Information, The University of Texas at Austin



Abstract

The mainstream adoption of smart watches and activity tracking wristbands has been fueled in large part by the desire to passively track health-related activities. While most of these devices perform well at monitoring physical and mobility-based behaviors such as walking and running, it would be particularly desirable for them to also quantify dietary behaviors. However, despite numerous research efforts, this type of activity detection has proved particularly challenging. In this talk, I will present highlights of our experience and on-going efforts with wrist-based food intake gesture spotting with commodity sensors (i.e., smart watches) across multiple studies and in a variety of settings. I will summarize our findings, discuss challenges and opportunities related to ground truth collection and sensor data annotation, and present novel study designs that aim at closing the gap between lab and in-the-wild studies.

Short bio

Edison Thomaz is a Research Assistant Professor in the Department of Electrical and Computer Engineering and the School of Information at The University of Texas at Austin. He holds a Ph.D. in Human-Centered Computing from the School of Interactive Computing of the Georgia Institute of Technology, and a S.M. in Media Arts and Sciences from the MIT Media Lab. Dr. Thomaz's research focuses on human-centered computational methods and systems for sensing, characterizing, modeling and predicting health+behavior signals and their interactions. Dr. Thomaz is currently an active member of the NIH-funded MD2K Center and an Associate Editor of the Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT). Prior to his academic appointments, Dr. Thomaz held industry positions at leading technology companies such as Microsoft and France Telecom.