BIOGRAPHICAL SKETCH

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NAME: Winfree, Kyle N.

eRA COMMONS USER NAME: winfree

POSITION TITLE: Assistant Professor in the School of Informatics, Computing, and Cyber Systems

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date MM/YYYY	FIELD OF STUDY
Northern Arizona University, Flagstaff, AZ	BS	12/2004	Physics
University of Pennsylvania, Philadelphia, PA	MSE	05/2009	Robotics
University of Delaware, Newark, DE	PhD	06/2013	Biomechanics and Movement Science
University of Delaware, Newark, DE	Postdoctoral	06/2013	Nursing

A. Personal Statement

My research focuses on development of the hardware and software systems to enable high quality community based assessments of human gait, physical activity, and behaviors. I have developed a research track on design and use of wearable devices to improve human health. I use a combination of both the standard, well-tested numerical analysis methods, and novel methods developed within my own research. In my previous research, I have developed taxonomies for classification of such human behaviors as freezing of gait (PD), walking, and eating. Using these developed taxonomies, I have then developed statistical learning classifiers, largely dependent on appropriate preprocessing of the data, to identify such behaviors from a multitude of different sensor source types. These statistical classifiers have all be trained using human observation as a gold standard. Further, I have applied advanced statistical methods of identifying undefined patterns in the data produced by such sets. Recently I have begun applying many of these methods to non-human mammals such as cattle.

B. Positions and Honors

2015 – present Assistant Professor in Informatics and Computing, Northern Arizona University, Flagstaff, AZ

C. Contributions to Science

1. **Parkinsonian Gait Assessment with a Wearable Device**
   During my doctoral work, myself and a team of engineers and nurses developed a device for assessing type and quality of gait in persons with Parkinson's disease. The foot-floor measures of pressure in this device varied greatly between subjects and sometimes even within a subject between days. The standard method of heel strike analysis was insufficient. As part of my dissertation, I developed a means of dynamically detecting each heel strike in data sets from our device. A related project within my doctoral work was a vibratory intervention device for persons with Parkinson's disease.
   a. **Winfree K. N.**, Pretzer-Aboff I, Agrawal S. K. (2014). Robust automated stride extraction from time-series contact force data: As applied to the PDShoe. IEEE Transactions on Neural Systems and Rehabilitation Engineering. DOI 10.1109/TNSRE.2014.2382641.
   b. **Winfree K. N.**, Milcarek B., Agrawal S. K., Pretzer-Aboff I. (2013). Identifying when changes to Parkinsonian gait occur within a vibratory intervention study. In Proc. 3rd World Parkinson Congress, October 2013.
   c. **Winfree K. N.**, Pretzer-Aboff I., Hilgart D., Aggarwal R., Behari M., & Agrawal S. (2012). An untethered shoe with vibratory feedback for improving gait of Parkinson's Patients: The PDShoe. 2012 Annual

International Conference of the IEEE Engineering in Medicine and Biology Society, 1202–1205. http://doi.org/10.1109/EMBC.2012.6346152

d. **Winfree K. N.**, Pretzer-Aboff, I., Hilgart, D., Aggarwal, R., Behari, M., & Agrawal, S. K. (2013). The effect of step-synchronized vibration on patients with parkinson's disease: Case studies on subjects with freezing of gait or an implanted deep brain stimulator. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 21(5), 806–811. http://doi.org/10.1109/TNSRE.2013.2250308

2. **Making Commodity Wearables Clinically Relevant**
As part of my postdoctoral work, I developed a Matlab/Octave data analysis library for Fitbit and ActiGraph data sets. This library enables one to time register the two different minute level resolution data sets when subjects concurrently wear both. I then developed a model to correct most of the errors reported from the Fitbit to more closely reflect the measures assessed by and ActiGraph device, thus demonstrating the capacity for the Fitbit to be used in place of an ActiGraph in some clinical studies. As part of this work, I expect to soon release the Matlab/Octave library for researcher use.

   a. Dominick G., **Winfree K. N.**, Pohlig R., Papas M. (2016). Physical Activity Assessment Between Consumer- and Research-Grade Accelerometers: A Comparative Study in Free-Living Conditions. JMIR MHealth and UHealth. https://dx-doi-org.libproxy.nau.edu/10.2196/mhealth.6281

   b. **Winfree K. N.**, Dominick G. (2017). Modeling Clinically Validated Physical Activity Using Commodity Hardware. IEEE International Biomedical and Health Informatics Conference (awarded top 14% paper of conference), February 2017.

   c. Barrett C., Dominick G., **Winfree K. N.** (2017). Assessing Bouts of Activity Using Modeled Clinically Validated Physical Activity on Commodity Hardware. IEEE International Biomedical and Health Informatics Conference, February 2017.

3. **Direct Assessment of Behavior and Movement Using Novel Specialized Wearable Devices**
My most recent work has focused on modeling behaviors, gait, and physical activity using custom wearable devices. This is the focus of my lab, the NAU Wearable Informatics Lab. I have several students working on different projects related to such topics. I am now in the second year of my assistant professor position at NAU, but have successfully recruited many students to work on aspects of wearable devices. Publications that have come from my lab thus far include the following.

   a. **Winfree K. N.**, Dmitrieva N. O., Behrens T. K. (2017) A Novel Method Of Assessing Dietary Behavior Using a Wrist-Worn Accelerometer. ACSM Annual Meeting, May 2017.

   b. **Winfree K. N.**, Hepp C. M. (2017) Assessing Physical Activity of Farm Animals with a Proxy Measure from Wearable Devices. IEEE International Biomedical and Health Informatics Conference, February 2017.

   c. Whitney C. D., Swenson G., **Winfree K. N.** (2017). KineTrax: a Wearable Device for Recording Kinematics in a Community Setting. ASU Rehabilitation Robotics Workshop, February 2017.

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/browse/collection/48721450/

D. Research Support
Ongoing and Pending Research Support

Arizona Department of Health Services AZNIA Winfree (PI) 2017-2020
This project proposes to address key concerns of stroke survivors that typically lead to moving out of one's own home and into an assisted living facility. To do this, this project will develop a harness support system for stroke survivors that can be installed inside their own home. This will require development of new technologies to enable a better range of motion than existing harness systems, both in the ability to travel between rooms and the ability to support standing and sit-to-stand or stand-to-sit motions.
Role: Principal investigator

Northern Arizona University Faculty Grant Dmitrieva (PI) 2017-2018
This study is designed to develop and test a feasible, culturally-acceptable, and appropriately-powered protocol for examining momentary pathways to overeating and sedentary behaviors in a racially and ethnically diverse sample.
Role: Co-Investigator

The NARBHA Institute Julie Baldwin (PI) 2016-2017
Advancing wellbeing in Northern Arizona. The goals of this project are to: 1) Conduct an assessment of health equity needs and intervention opportunities in northern Arizona. 2) Advance knowledge on wellbeing strategies

through multi-disciplinary targeted research.
Role: Key Participant

Health Resources and Services Administration Denise Helm (PI) 2015-2019
Women and Infants' (PZWI) mission is to expand opportunities for access to direct oral health services; increase delivery of best practices for oral healthcare; and enhance statewide data sources.
Role: Key Participant

Completed Research Support

National Science Foundation Kiisa Nishikawa (PI) 2015-2016
The broader impact/commercial potential of this project includes development of robust control algorithms for a robotic, foot-ankle prosthesis based on the winding filament hypothesis, a transformative new idea about how muscles contract.
Role: Key Participant