Qu Tang

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Research interest: Mobile health, ubiquitous computing, personalized and interactive machine learning, deep learning, sports and exercise science, human behavior modeling

Education

Northeastern University, Boston, MA US — Sep 2013 – Aug 2021
Ph.D. in Computer Engineering
Advisor: Stephen Intille

Northeastern University, Boston, MA US — Jan 2011 - May 2013
M.S. in Electrical Engineering
Advisor: Stephen Intille

University of Electronic Science and Technology of China, Chengdu, Sichuan PRC — Sep 2006 - May 2010
B.E. in Electric Science and Technology

Research Experience

Northeastern University, Boston, MA US — Sep 2013 - Aug 2021
Graduate Research Assistant, mhealth Research Group

Schepens Eye Research Institute, Boston, MA US — Dec 2011 - Aug 2012
Coop Research Assistant, Vision Rehabilitation Laboratory

Selected Publications

Tang, Q., John, D., Chhetry, B.T., Arguello, D. and Intille, S., 2020. Posture and Physical Activity Detection: Impact of Number of Sensors and Feature Type. **Medicine & Science in Sports & Exercise**, 52(8), pp.1834-1845, doi: 10.1249/MSS.0000000000002306.

John, D.*, **Tang, Q.***, Albinali, F., and Intille, S., 2019. An Open-Source Monitor-Independent Movement Summary for Accelerometer Data Processing. **Journal for the Measurement of Physical Behavior**, 2(4), pp.268-281.

Tang, Q., Vidrine, D.J., Crowder, E., and Intille, S.S., 2014. Automated detection of puffing and smoking with wrist accelerometers. In Proceedings of the 8th International Conference on **Pervasive Computing Technologies for Healthcare**, pp. 80-87. ICST.

Goodwin, M.S., Haghighi, M., **Tang, Q.**, Akcakaya, M., Erdogmus, D., and Intille, S., 2014. Moving towards a real-time system for automatically recognizing stereotypical motor movements in individuals on the autism spectrum using wireless accelerometry. In Proceedings of the 2014 ACM **International Joint Conference on Pervasive and Ubiquitous Computing**, pp. 861-872. ACM.

Invited Presentations

Aditya Ponnada, Seth Cooper, **Qu Tang**, Binod Thapa-Chhetry, Josh Miller, Dinesh John, and Stephen Intille. (2021, March). A Tool to Explore and Annotate Multi-day Raw Accelerometer Data. In 2021 IEEE **International Conference on Pervasive Computing and Communications Workshops** (PerCom Workshops).

Q. Tang, A. Ponnada, S. Intille, “Towards Personal Hand Hygiene Detection in Free-living Using Wearable Sensors,” at the **Machine Learning for Mobile Health NeurIPS 2020 Workshop** (Online virtual), December 2020.

S. Intille, D. John, R. Troiano, **Q. Tang**, and B. Thapa Chhetry, “Processing Terabytes of NHANES and NNYFS Wrist Accelerometer Data for Public Access,” at the 2019 **Annual Meeting of the American College of Sports Medicine** (ACSM), May 2019.

Honors and Awards

Spotlight Presentation, at the Machine Learning for Mobile Health NeurIPS 2020 Workshop

Outstanding Student Award, Ph.D. data science immersion program hackathon, Wayfair LLC, Boston

National Scholarship of China for bachelor studies in UESTC, PRC from 2007 to 2009

Service and Leadership

Reviewer, IEEE Sensors, ACM IMWUT, AAAI

Seminar Coordinator, Personal Health Informatics Seminar Speaker Series, Northeastern University, Boston

Student Member, IEEE, ACM, and ACSM (American college of Sports Medicine)

Core Contributor (Open source), MIMSunit R package, Signaligner Pro software

Teaching Assistant, Computer Graphics (Spring, 2016), Northeastern University, Boston

Mentor, Research experiences for undergraduates (REU-D3, 2008-2009), Northeastern University, Boston

Skills

UX & HCI Research: Qualitative, Quantitative, Experiments, Interviews (Users & Experts), Questionnaire Designs, Experience Sampling, Ecological Momentary Assessment Design

Programming, Python (6Y), C/C++ (2Y), Java (5Y), Kotlin (1Y), R (3Y), Bash (1Y), MATLAB (2Y), JavaScript (2Y), SQL (1Y), HTML, CSS

Data Analytics & Statistics: Supervised learning, Neural Networks, Clustering, Time Series Analysis, Digital Signal Processing, Univariate & Multivariate Statistics

Software/Frameworks: Android, Linux, SPSS, MS Office, PyTorch, Pandas & NumPy, Scikit-learn

Publications

Tang, Q., John, D., Chhetry, B.T., Arguello, D. and Intille, S., 2020. Posture and Physical Activity Detection: Impact of Number of Sensors and Feature Type. **Medicine & Science in Sports & Exercise**, 52(8), pp.1834-1845, doi: 10.1249/MSS.0000000000002306.

John, D.*, **Tang, Q.***, Albinali, F., and Intille, S., 2019. An Open-Source Monitor-Independent Movement Summary for Accelerometer Data Processing. **Journal for the Measurement of Physical Behavior**, 2(4), pp.268-281.

Henwood, B., Redline, B., Dzubur, E., Madden, D., Rhoades, H., Dunton, G., Rice, E., Semborski, S., **Tang, Q.** and Intille, S., 2019. Investigating health risk environments for in housing programs for transition-aged youth. **Annuals of Behavioral Medicine**, 53, pp. S336-S336.

Houston, K.E., Bowers, A.R., Fu, X., Liu, R., Goldstein, R.B., Churchill, J., Wiegand, J.P., Soo, T., **Tang, Q.** and Peli, E., 2016. A pilot study of perceptual-motor training for peripheral prisms. **Translational vision science & technology**, 5(1), pp.9-9.

Goodwin, M.S., Haghighi, M., **Tang, Q.**, Akcakaya, M., Erdogmus, D., and Intille, S., 2014. Moving towards a real-time system for automatically recognizing stereotypical motor movements in individuals on the autism spectrum using wireless accelerometry. In Proceedings of the 2014 ACM **International Joint Conference on Pervasive and Ubiquitous Computing**, pp. 861-872. ACM.

Tang, Q., Vidrine, D.J., Crowder, E., and Intille, S.S., 2014. Automated detection of puffing and smoking with wrist accelerometers. In Proceedings of the 8th **International Conference on Pervasive Computing Technologies for Healthcare**, pp. 80-87. ICST.

References

Reference letter will be provided upon request.

Research Projects

Exploring the use of Real-Time Activity Recognition to Support Hand Hygiene Jan 2020 - Present

Project Lead and co-PI, Northeastern University, Boston, US

In response to the global COVID-19 pandemic, this study aims to develop a real-time, personalized interactive activity recognition system that can detect handwashing and face touching behaviors using inertial sensors of smartwatches. The system utilizes attention neural networks to retrieve complex temporal features and user behavior model-based active learning algorithm to gather ground truth in the on-the-move, free-living environment.

The system has been validated to detect 75% face touching and 100% handwashing instances in free-living on a 10-participant, eight-hour study.

Temporal influences on Movement and Exercise Study Sep 2019 - Present

Data engineer, Northeastern University, Boston, US

The goal of this study is to understand how different contextual and situational factors explain the adoption and maintenance of health behaviors. A combination of phone-based experience sampling, wearable-based micro-EMA, and passive sensing using the phone's and smartwatch's embedded sensors is used to build predictive models of health behavior at the individual and group levels. A prospective within-subject case-crossover observational study is being conducted across a 12-month period among ethnically diverse, emerging adults (ages 18-29, number of participants: 200). Fund: NIH/NHLBI.

Developing a Computational Pathway and Algorithms to Summarize Large-Scale Accelerometer Data Jan 2017 - Dec 2018

Algorithm developer, Northeastern University, Boston, US

The goal of the study is to develop non-proprietary and open-source methods for screening and summarizing large amounts of accelerometer data collected in important health surveillance studies such as the NHANES and the UK Biobank. A sensor data summarization algorithm that harmonizes heterogeneous inputs using localized regression and bandpass filtering, a sleep-wear-nonwear detection algorithm using hierarchical supervised learning to fuse high-level sleep pattern features with low-level motion pattern features, and an automated screening detection algorithm using peak finding and template matching have been developed and published. The algorithms developed in this study has been officially selected to process the 18k+ dataset of raw accelerometer data from NHANES (7TB), computing motion summaries and sleep, wear, and non-wear states. Fund: NIH.

Signaligner Pro: Supporting Multi-day Raw Sensor Data Annotation Sep 2019 - Dec 2020

App developer, Northeastern University, Boston, US

The open-sourced tool was developed to enable activity recognition, physical activity, and sleep behavior researchers interested in using raw sensor data to explore and annotate high-sampling rate raw data collected on individuals for a week of data or more. The tool was developed as a web app using WebGL, multi-level downsampling and max-min decimation to ensure high-performance graph rendering and user interaction for large amount of raw sensory data. The tool has been used to label data (>100 GB) for prolonged and short-lived physical activities. It was the first of its type to support viewing and labeling data of a week or more. The tool is available on GitHub: https://signaligner.org.

CamSPADES and SPADES Physical Activity Measurement study Jan 2015 - Dec 2018

Project lead, Northeastern University, Boston, US

This study aims to measure up to 30 common daily physical activities for adults and elders with passive sensing in free-living. The study produced two public datasets (number of participants: 100, 1TB) that include a rich set of sensory data (i.e., raw accelerometer data from multiple sensors on different limbs, phone usage logs, watch usage logs) and that includes up to 30 activity types collected in simulated free-living and free-living environment. A multi-site activity recognition algorithm using SVM and rich time- and frequency-domain features has been developed and validated on the datasets. The algorithm achieved the state-of-the-art performance at the time of publication in classifying up to 22 free-living-alike activity types with an F1-score of 0.75. The datasets are available at: https://www.mhealthgroup.org/datasets.html. Fund: NIH.

Understanding HIV Risk Environment for Youth in Supportive Housing Jan 2015 - Dec 2017

App developer, Northeastern University, Boston, US

Supportive housing (SH) is a structural intervention that is being increasingly applied to homelessness among transition aged youth (TAY). Despite its positive effects, SH may promote risky behaviors that increase HIV rates. This study investigates the mechanisms that explain the association between SH and HIV risk behaviors. A user study was conducted for 200 participants using a comprehensive, context-sensitive ecological momentary assessment (EMA) app that can robustly collect social-interaction, emotion, and daily routines information for 24/7 over six months. The app supports complex EMA designs. Fund: NIH.

Automatic Detection of Smoking Behavior Jan 2014 - Dec 2014

Project lead, Northeastern University, Boston, US

The study aims to develop an efficient pattern recognition algorithm that can automatically detect smoking behaviors using wrist inertial sensors. A hierarchical machine learning model was developed using Random Forest to classify low-level motion pattern features and then using linear regression to fuse with high-level smoking pattern features. The model was evaluated on a seven-participant, 14-hour free-living dataset and achieved the state-of-the-art performance at the time of publication (F1-score of 0.8 for puffing recognition and 0.9 for smoking recognition). Fund: American Cancer Society.

Stereotyped Behavior Detection for Children with Autism Spectrum Disorder Sep 2013 - May 2014

Algorithm developer, Northeastern University, Boston, US

The study aims to develop an efficient pattern recognition algorithm that can detect three stereotyped motions for children with autism spectrum disorder using wrist and torso inertial sensors. Supervised learning model was developed using Decision Tree and SVM with multidimensional spectrum features computed with stockwell transform. The model was evaluated on two six-participant two-year-apart datasets. Despite its state-of-the-art performance on each of the dataset (Accuracy: >0.9), the inner-person variability was identified when the model was cross-validated on the two datasets, which was an important insight to develop such systems that work over time. Fund: National Alliance for Autism.