Sungtae Shin

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Current Position

● Postdoctoral Associate @ Dept. of Mechanical Eng., University of Maryland

Research Topics: time-series signal processing / machine learning for human physiological signals / cuff-less blood pressure monitoring / mock circulatory loop
Supervisor: *Dr. Jin-Oh Hahn*

Apr. 2017 ~ Present
College Park, MD

Education

● Texas A&M University (TAMU)
Ph.D., Mechanical Engineering

Sep. 2011 ~ Dec. 2016
College Station, TX
GPA: 3.57/4.0

Advisor: *Prof. Reza Langari* (Professor @ ME & Dept. Head @ Engineering Technology and Industrial Distribution, Texas A&M)
Co-Advisor: *Prof. Reza Tafreshi* (Associate Professor @ ME, Texas A&M at Qatar)
Dissertation Title – "*Myoelectric Human Computer Interaction Using Reliable Temporal Sequence-based Myoelectric Classification for Dynamic Hand Gestures"*
: In this dissertation, a myoelectric signal-based human computer interface (HCI) system was proposed to operate 7-DOF robot manipulator including a 1-DOF gripper in real-time. In order to translate human gestures as robot commands, a dynamic hand gesture recognition method via only myoelectric signals was developed. The recognition method classifies dynamic motions based on comparing the correlation of myoelectric signals of each dynamic motion via a dynamic time warping (DTW) technique. In this study, signal processing techniques for EMG (electromyogram) and IMU (inertia measurement unit) data; machine learning techniques to recognize human hand gestures through myoelectric signals, and implementation techniques for the real-time operation were carried out.
Links:

- Myoelectric interface with dynamic motion (Video: https://youtu.be/3U0BZYAzjgg)
- Classifying dynamic hand motions in real-time (Video: https://youtu.be/Cv0W0GkFOok)
- Operating myoelectric interface (Video: https://youtu.be/6f3HbSTvu_c;
  Article: http://tees.tamu.edu/news/2016/08/04/texas-am-student-developing-myoelectric-signal-capture-to-help-patient-recovery)

● Sejong University
M.S., Mechanical Engineering

Mar. 2004 ~ Feb. 2006
Seoul, South Korea
GPA: 3.7/4.0

Advisor: *Prof. Young-Gy Shin* (Professor @ ME, Sejong Univ., Korea)
Thesis Title – *"A Study on the Vehicle's HVAC Controller Development Using a Real-Time Simulator"*
: In this thesis, a real-time simulation environment including a dynamic model of a vehicle HVAC system was constructed by using the XPC target tool/Matlab. In order to connect the simulator and manufacturer's HAVC controllers, a data interface board was also designed. Through this system, the performance of a manufacturer's HAVC controller and our PID and Fuzzy controllers were tested and compared with each other. In this study, the HVAC dynamic model was built by Simulink/Matlab and the interface board was developed by an 8-bit microcontroller. The Modbus protocol was used to transfer input/output data between the simulator and the interface board.

● Sejong University
B.S., Mechanical Engineering (Minor: Electrical Engineering)

Mar. 2000 ~ Feb. 2004
Seoul, South Korea
GPA: 3.7/4.0

RESEARCH INTERESTS

Bio-signal Processing; Machine Learning; Temporal Pattern (Sequence) Recognition; Human Computer Interface; Gesture Recognition; Robotics; Mechatronics; Cuff-less Blood Pressure Measurement; Regression Model (for Human Physiological Signals)

RESEARCH EXPERIENCE

● Postdoctoral Associate

Role: Researching control systems, regression models, and signal processing and for human physiological signals
Supervisor: Dr. Jin-Oh Hahn

Apr. 2017 ~ Present
Mechanical Engineering (ME),
University of Maryland,
College Park, MD, US

● Guest Worker

Role: Developing and automating a mock circulatory loop (i.e., simulating the heart and circulatory system) w/ an in-vitro arm phantom system to evaluate and test oscillometric non-invasive blood pressure monitors
Supervisor: Dr. Luke Herbertson and Dr. Jin-Oh Hahn

Jul. 2017 ~ Present
U. S. Food and Drug Administration (FDA),
Silver Spring, MD, US

● Research Assistant

Role: Researching for Myoelectric Human Computer Interface
Supervisor: Prof. Reza Langari

Jan. ~ Mar. 2017
Engineering Technology & Industrial Distribution (ETID),
Texas A&M University (TAMU),
College Station, TX, US

● Graduate Research Assistant

Role: Researching Human Computer Interface and gesture recognition via EMG signals
Advisor: Prof. Reza Langari

Sep. 2014 ~ Dec. 2016
ETID,
TAMU,
College Station, TX, US

● Graduate Research Assistant

Role: Conducting preliminary research for manipulating prosthetics and recognizing human gestures via EMG signals
Advisor: Prof. Reza Tafreshi

Sep. 2012 ~ Aug. 2013
ME,
Texas A&M University at Qatar,
Doha, Qatar

● Graduate Research Assistant

Role: Researching Human Computer Interface and gesture recognition via EMG signals
Advisor: Prof. Reza Langari

Sep. 2011 ~ May. 2012
ME,
TAMU,
College Station, TX, US

● Research Scientist

Role: Developing software applications for manipulating and communicating robots; and solving path planning and task allocation problems for multiple robotic manipulators
Advisor: Dr. Yong-Kwun Lee

Oct. 2009 ~ Aug. 2011
Center for Bionics,
Korea Institute of Science and Technology,
Seoul, South Korea

● Graduate Research Assistant

Role: Developing a real-time simulator for vehicle HVAC system (middleware for the data communication and firmware for microcontrollers)
Advisor: Prof. Young-Gy Shin

Mar. 2004 ~ Dec. 2005
ME,
Sejong University,
Seoul, South Korea

● Undergraduate Research Assistant

Role: Developing middleware for the data communication in data acquisition systems and firmware for microcontrollers
Advisor: Prof. Young-Gy Shin

Mar. 2001 ~ Feb. 2004
ME,
Sejong University,
Seoul, South Korea

WORK EXPERIENCE

● Control Engineer

Role: Developing motion & trajectory planning for 3D motion stages and embedded systems for semiconductor manufacturing equipment

Jan. 2006 ~ Apr. 2009
Dukin (www.dukin.co.kr)
Daejeon, South Korea

REFEREED PUBLICATIONS AND SUBMITTED ARTICLES

- **Published and Accepted Journal Articles**

J1. Y Yao, **S. Shin**, …, J. Hahn (2019). Unobtrusive Estimation of Cardiovascular Parameters with Limb Ballistocardiography. *Sensors*, 19(13), 2922. https://doi.org/10.3390/s19132922

J2. P. Yousefian, **S. Shin**, …, J. Hahn (2019). The Potential of Wearable Limb Ballistocardiogram in Blood Pressure Monitoring via Pulse Transit Time. *Scientific Reports*, 9(1), 10666. https://doi.org/10.1038/s41598-019-46936-9

J3. P. Yousefian, **S. Shin**, … J. Hahn (2019). Physiological Association between Limb Ballistocardiogram and Arterial Blood Pressure Waveforms: A Mathematical Model-Based Analysis. *Scientific Reports*, 9(1), 5146. https://doi.org/10.1038/s41598-019-41537-y

J4. P. Yousefian, **S. Shin**, …, J. Hahn (2018). Data Mining Investigation of the Association between a Limb Ballistocardiogram and Blood Pressure. *Physiological Measurement,* 39(7), 075009. **[Featured Article 07/2018]** https://doi.org/10.1088/1361-6579/aacfe1

J5. **S. Shin**, R. Tafreshi, & R. Langari (2018). Real-time Myoelectric Interface Using Dynamic Hand Gestures for a Multiple-DoF Robot Arm. *Journal of Intelligent & Fuzzy Systems,* 35(1), 861-876. https://doi.org/10.3233/JIFS-171562

J6. B. Yapps, **S. Shin**, …, A. T. Reisner (2017). Hypotension in ICU Patients Receiving Vasopressor Therapy. *Scientific Reports*, 7(1), 8551. https://doi.org/10.1038/s41598-017-08137-0

J7. **S. Shin**, R. Tafreshi, & R. Langari (2016). Robustness of Using Dynamic Motions and Template Matching to the Limb Position Effect in Myoelectric Classification. *Journal of Dynamic Systems, Measurement, and Control*, 138(11), 111009. https://doi.org/10.1115/1.4033835

- **Submitted Journal Articles** (with date of submission)

- **Journal Articles In Preparation**

JP1. **S. Shin**, …, J. Hahn. Forecasting Hypotension in Patients with Vasopressor Therapy via Blood Pressure Time Series Analysis.

- **Conference Presentation with Proceedings (Refereed)**

C1. **S. Shin**, A. Reisner, …, J. Hahn (2019). Forecasting Hypotension during Vasopressor Infusion via Time Series Analysis. In 2019 41st Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) at Berlin, Germany 23-27 July 2019 (**Accepted**)

C2. P. Yousefian, **S. Shin**, …, J. Hahn (2019). Blood Pressure Tracking with Wearable Wrist Ballistocardiography. In 2019 IEEE International Conference on Biomedical and Health Informatics (BHI) at Chicago, IL, USA 19-22 May 2019 (**Accepted**)

C3. **S. Shin**, R. Tafreshi, & R. Langari (2017). Real-time EMG-based Human Machine Interface using dynamic hand gestures. In *2017 American Control Conference (ACC)* (pp. 5456–5461). IEEE. https://doi.org/10.23919/ACC.2017.7963803

C4. **S. Shin**, R. Tafreshi, & R. Langari (2016). Myoelectric pattern recognition using dynamic motions with limb position changes. In *2016 American Control Conference (ACC)* (Vol. 2016–July, pp. 4901–4906). IEEE. https://doi.org/10.1109/ACC.2016.7526129

C5. **S. Shin**, R. Langari, & R. Tafreshi (2014). A Performance Comparison of EMG Classification Methods for Hand and Finger Motion. In *2014 Dynamic Systems and Control Conference (DSCC)* (p. V002T16A008). ASME. https://doi.org/10.1115/DSCC2014-5993

C6. **S. Shin**, R. Tafreshi, & R. Langari (2014). A performance comparison of hand motion EMG classification. In *2nd Middle East Conference on Biomedical Engineering* (pp. 353–356). IEEE. https://doi.org/10.1109/MECBME.2014.6783276

C7. H. Moon, N. P. Robson, R. Langari, & **S. Shin** (2014). An experimental study on redundancy resolution scheme of postural configuration in human arm reaching with an elbow joint kinematic constraint. In *2nd Middle East Conference on Biomedical Engineering* (pp. 257–260). IEEE. https://doi.org/10.1109/MECBME.2014.6783253

- **Posters & Abstracts**

PA1. L. Herbertson, **S. Shin**, …, & J. Rinaldi (2018). Development Of Mock Circulatory Loops To Assess VAD Performance. In 2018 ASAIO 64th Annual Conference (p. 258) (Abstract)

PA2. Gavin D'Souza, …, **S. Shin**, …, Luke Herbertson (2019). Generating Different Heart Failure Conditions on the Bench to Predict VAD Performance. In 2019 ASAIO 65th Annual Conference (Poster)

OTHER PUBLICATIONS AND CREATIVE PRODUCTS

- **Patents**

PT1. Apparatus and Method for Estimating Blood Pressure. KR Patent Application KR 10-2018-0167746, filed 12/21/2018. *Patent Pending*.

PT2. Blood Pressure Measurement Apparatus and Method. KR Patent Application KR 10-2018-0028683, filed 03/12/2018. *Patent Pending*.

- **Invention disclosure at the University of Maryland**

ID1. Cuff-Less Blood Pressure Monitoring with Wearable Ballistocardiography. Reference Number PS-2018-030.

ID2. Cuff-Less Blood Pressure Monitoring with Model-Based Analysis of Wearable Ballistocardiography. Reference Number PS-2019-025.

PROFESSIONAL ACTIVITIES AND SERVICES

● Journal Reviewer Experience

- *Journal of Intelligent and Fuzzy Systems*	**Dec. 2012 ~ Present**
- International Conference on Ubiquitous Robots	**Mar. 2018 ~ Present**
- Medical & Biological Engineering & Computing	**Mar. 2018 ~ Present**
- Dynamic Systems and Control Conference	**Apr. 2018 ~ Present**
- IEEE Journal of Biomedical and Health Informatics	**May 2018 ~ Present**
- Physiological Measurement	**Oct. 2018 ~ Present**
- IEEE Sensors Journal	**Nov. 2018 ~ Present**
- Computers in Biology and Medicine	**Nov. 2018 ~ Present**
- Health and Technology	**Dec. 2018 ~ Present**
- IEEE-EMBS International Conference on Biomedical and Health Informatics	**Feb. 2019 ~ Present**
- International Journal of Control, Automation and Systems	**Feb. 2019 ~ Present**
- IEEE Access	**Jun. 2019 ~ Present**

● Invited Talks (excluding conference presentations)

- Title: "*Introduction to Bio-signal processing*" — **Aug. 14, 2014**, Sejong University, Seoul, South Korea

● Mentoring

- ***AggiE-Challenge 2014/2015, Texas A&M University Engineering*** — **Sep. 2014 ~ Aug. 2015**, TAMU, College Station, TX, US

Role*:* Mentoring undergraduate students who participated in an AggiE-Challenge 2014/2015 project named "EMG-based Control of a Robotic Arm through Hand Gestures"

- ***Blair Magnet Research Program (Summer Internship)*** — **Jun. ~ Aug. 2019**, University of Maryland, College Park, MD, US

Role: Mentoring a high-school student (Elisabeth Jang), who participated in the Blair Magnet Research Program, for human subject experiments of wrist BCG waveform at different postures

HONORS AND AWARDS

- **ASME DSCC Student Travel Grant** (awarded to the selective papers), ASME 2014 Dynamic Systems and Control Conference	**Aug. 2014,** San Antonio, Texas, USA
- **Graduate Assistant Fellowship** (Research)	**Sep. 2014 ~ Aug. 2016,** Texas A&M University
- **Graduate Assistant Fellowship** (Research)	**Sep. 2012 ~ Aug. 2013,** Texas A&M University at Qatar
- **Charles W. Crawford Fellowship**	**Sep. 2011 ~ May 2012,** Texas A&M University
- **Graduate Assistant Fellowship** (Grading/Teaching)	**Sep. 2011 ~ May 2012,** Texas A&M University
- **Graduate Assistant Fellowship** (Research/Teaching)	**Mar. 2004 ~ Feb. 2006,** Sejong University
- **Academic Scholarships**	**Mar. 2000 ~ Feb. 2004,** Sejong University

TECHNICAL SKILLS

- VC++ & C# for windows programing (multi-thread & TCP/IP)
- Embedded C for micro-controller and middleware (RS232 & TCP/IP programming)
- Matlab & Simulink for engineering and research
- Python for signal processing & machine learning
- Microsoft .Net & PHP, HTML, MySQL, MS-SQL for web & database programming
- LabVIEW (acquired Certified LabVIEW Associate Developer (CLAD) on Jun. 4, 2015)