

# Yuanyuan Gao

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Rensselaer Polytechnic Institute, 110 8<sup>th</sup> street

Troy, NY, USA

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## EDUCATION

Rensselaer Polytechnic Institute

Ph.D. Mechanical Engineering; GPA 3.5

Beihang University

M.S. Mechanical Engineering; GPA 3.6

Beihang University

B.S. Aircraft Environment and Life Security Engineering; GPA 3.4

*Expected to graduate: July 2020*

Advisors: Prof. Xavier Intes, Prof. Suvaranu De

*2010 - 2013*

Advisors: Prof. Chao Yun

*2006 - 2010*

## RESEARCH EXPERIENCE

Graduate Research Assistant at Rensselaer Polytechnic Institute

Visiting Scholar at University of Buffalo

Researcher at Harvard Medical School

*2015 – Present*

*Feb 2019 – Oct 2019*

*Feb 2016*

## RESEARCH PROJECTS

- Project 1 (PhD thesis): Evaluating brain activation changes during motor learning via functional near-infrared spectroscopy (fNIRS) under neurostimulation conditions
  - Instructors: Dr. Suvaranu De and Dr Xavier Intes
  - In a short-term crossover training study (1 day), I demonstrated that the left prefrontal cortex (PFC), middle primary motor cortex (M1) and supplementary motor area (SMA) were activated revealed by fNIRS technique after transcranial random noise stimulation (tRNS) and the bimanual motor skills were enhanced as well.
  - In a long-term grouped training study (12 days with follow-up visit and transfer tasks), I demonstrated that tRNS suppressed the activation in PFC and tDCS enhanced it in M1 region. The follow-up visit and transfer task performance was not significantly different across the conditions while transfer task demanded 10 times higher oxygen across the brain.
- Project 2: Predicting surgical skills from fNIRS via deep learning models
  - Instructor: Dr. Pingkun Yan
  - I achieved an accuracy of  $R^2 = 0.73$  and  $AUC = 0.91$  by designing a convolutional neural network (CNN) model to extract features from fNIRS data to regress out the motor skill level, which is much higher than conventional machine learning models, including support vector regression (SVR), kernel partial least squares (KPLS) and random forest (RF) algorithms.
- Project 3: Predicting learning curve characteristics via machine learning approaches
  - Instructor: Dr. Uwe Kruger
  - I successfully predicted the learning curve characteristics from the initial ten trials performance of the medical students ( $R^2 = 0.81$ ) by employing the machine learning approach, KPLS. I further classified the students into two groups with unique learning characteristics through an unsupervised machine learning algorithm, k-means algorithm, revealing the motor learning nature of human.
- Project 4: Removing motion artifacts in fNIRS data via deep learning approach
  - Instructor: Dr. Pingkun Yan

- I constructed a sophisticated designed denoising autoencoder model to remove the motion artifact existing in fNIRS data, with lower error than conventionally used denoising methods. It is a pioneering work in fNIRS data processing field as the first to introduce deep learning approach and has opened a new chapter.
- Project 5: Literature review on neuroimaging studies
  - Instructor: Dr. Lora Cavuoto
  - I contributed to the general education of the neuroimaging field by composing a comprehensive review paper on neuroimaging studies, including fNIRS, fMRI, EEG, PET, and MEG modalities, on how those neuroimaging techniques revealed human motor learning nature and how transcranial electrical stimulation affects it. This work is well received by peer scholars.

## **TEACHING EXPERIENCE**

### Graduate Teaching Assistant

Thermal and Fluid Engineering

Department of Mechanical, Aerospace and Nuclear Engineering

Instructors: Dr. Diana-Andra Borca-Tasciu; Dr. Daniel Lander

Fall 2015; Spring 2018

### Graduate Teaching Assistant

Modeling and Analysis of Uncertainty

Fall 2016; Spring 2017  
School of Engineering at RPI

Instructor: Dr. Bimal K. Malaviya

### Guest Lectures

Modeling of Biomedical Systems

Fall 2018  
Department of biomedical engineering at RPI

Instructor: Dr. Uwe Kruger

### Undergraduate Student Mentor

fNIRS data processing and analysis

Spring 2018; Summer 2018  
Undergraduate Research Program (URP) at RPI

Instructor: Dr. Suvranu De

UG students: Jeanine Moreau; Yanting Liu; Yiyang Huang.

## **PUBLICATIONS**

### Journal papers

**Yuanyuan Gao**, Uwe Kruger, Steven Schwaartzberg, Xavier Intes and Suvranu De, “A Machine Learning approach to predict surgical learning curves”, *Surgery*, 167.2 (2020): 321-327.

**Yuanyuan Gao**, Pingkun Yan, Uwe Kruger, Lora Cavuoto, Steven Schwaartzberg, Suvranu De and Xavier Intes, “Functional brain imaging reliably predicts bimanual motor skill performance in a standardized surgical task”, *IEEE TBME*, under review, [Preprint](#).

**Yuanyuan Gao**, Lora Cavuoto, Steven Schwaartzberg, Jack E. Norfleet, Xavier Intes and Suvranu De, “A comprehensive review of experimental neuroimaging studies of the effect of transcranial electrical stimulation on human motor skills”, *Brain Stimulation*, submitted, [Preprint](#).

### Conference papers

**Yuanyuan Gao**, Lora Cavuoto, Pingkun Yan, Uwe Kruger, Steven Schwaartzberg, Suvranu De and Xavier Intes, “A deep learning approach to remove motion artifacts in fNIRS data analysis”, *OSA Biophotonics Congress: Biomedical Optics, Florida, USA, April 2020. (Oral presentation)*

**Yuanyuan Gao**, Lora Cavuoto, Pingkun Yan, Uwe Kruger, Jessica Silvestri, Steven Schwaartzberg, Suvranu De and Xavier Intes, “Monitoring the effect of transcranial Electric current Stimulation (tES) during a bimanual motor task via functional Near-Infrared Spectroscopy (fNIRS)”, *OSA Biophotonics Congress: Biomedical Optics, Florida, USA, April 2020. (Poster presentation)*

**Yuanyuan Gao**, Pingkun Yan, Uwe Kruger, Suvranu De and Xavier Intes, “Neuroimaging biomarkers for surgical skill level prediction”, *SPIE.bios, San Francisco, CA, February 2019. (Poster presentation)*

**Yuanyuan Gao**, Pingkun Yan, Uwe Kruger, Suvaranu De and Xavier Intes, “fNIRS as a quantitative tool to assess and predict surgical skills”, *OSA Biophotonics Congress: Optics in the Life Sciences, Tucson, AZ, April 2019. (Oral presentation)*

**Yuanyuan Gao**, “Research on the location assignment problem of automation of pharmacy storage”, *The ninth Session of Graduate Student Academic Forum of Beijing University (Conference paper)*

### Patents

“Access Mechanism of Automatic Pharmacy Storage Systems”, 201210110543X

“Pneumatic Medicine Out-putting Device and Method”, 2012100914371

“Pneumatic Rod-type Medicine Out-putting device and method”, 2012101268206

### CERTIFICATION

Introduction to transcranial direct current stimulation (offline)

March 2016

Harvard Medical School

Databases and SQL for Data Science (online)

March 2020

Coursera

### SKILLS

*Programming Language:* **Python**, C/C++/C#, VB, SQL;

*Statistical Tools:* **Matlab**, SPSS, Minitab, G\*Power;

*Computer Aided Design/Engineering:* Solidworks, CATIA, autoCAD, ANSYS, NX, CFD;

*Operating Systems:* Windows, Linux (Ubuntu) and Mac OS;

*Hardware:* fNIRS spectrometers; Trans-cranial electrical stimulation device; Laparoscopic skill trainer;

*Others:* Microsoft Office Series, Latex.

*Language:* Proficient in English and Mandarin.

### ACADEMIC AWARDS

- Outstanding Graduate in Beijing, 2013
- BUAA Graduate Students Second Prize Scholarship, 2011
- BUAA undergraduate Students Second Prize Scholarship, 2007

### OTHER RESEARCH EXPERIENCE

#### Master Projects

Aug 2010 – Jul 2013

Advisor: Chao Yun

- 90kg Palletizing Robot Program

- Mechanical structure design and motion simulation analysis of wrist, big arm, rear arm and waist part using Solidworks software; All engineering drawings by CAXA software;
- Debug the system using PMAC motion control card;
- Responsible for motor, rail, belt wheels calculation, selection and procurement.

- Automatic Pharmacy Storage Systems program

- Undertook project prophase investigation, proposed solutions with widely various ideas;
- Access mechanism system were analyzed, and optimal scheme of improvement was given through ADAMS software;
- The stress static and dynamic analysis and vibration analysis of elevator system were given using ANSYS software, and improve the structure to enhance the rigidity strength and vibration performance;
- Mechanical structure design of prototype experimental platform using SolidWorks software and participate in the process of manufacture;

- Debugged the system prototype using PLC, programmed the PC management software using C#.NET, program genetic algorithm to optimize the simulation calculation to the storage location assignment by Matlab.

**Undergraduate Projects***Sept 2006-Jul 2010*

Advisor: Yong Huang

- A Small Wind Tunnel Design
  - Designed 3-D mechanical structure and drawing work of the small wind tunnel.
- Study on Numerical Cabin Pressure Control System
  - The flow fields of the butterfly and gate outflow valves in the numerical cabin pressure control system are numerically simulated and calculated.

**WORK EXPERIENCE**SAIC Motor Commercial Vehicle Technical Center*Shanghai, China*

IP (Instrument Panel) &amp; DP (Door Panel) Engineer

*Aug 2013 - Jun 2015*

- Program: SV71 Main responsible parts: Console
  - Achievement: changing design of Console to enlarge the storage space and right rudder Console Development project
- Program: SV61& EV69 Main responsible parts: IP and DP
  - Achievement: Quality Improvement Project
  - Award: New Start of Season of the Department of Body and Design

**OTHER EXPERIENCE**

- College women's volleyball team captain *Sept 2006*
- Volunteer, Beijing 2008 Olympics *Aug 2008*
- Internship, Nanjing electrical and hydraulic center *July 2009*
- Internship as Assistant of production department; Akivator(Kunshan) *Aug 2011*
- Internship as Project Manager of Automated pharmacy store, IRON(Suzhou) *Aug 2012*