

# DARIN TSUI

+1(909) 306-4398 ♦ San Diego, CA

[dtsui@ieee.org](mailto:dtsui@ieee.org) ♦ [linkedin.com/in/darintsui/](https://www.linkedin.com/in/darintsui/) ♦ [github.com/darintsui](https://github.com/darintsui)

Biomedical engineering undergraduate with a focus on machine learning and artificial intelligence. My research specialization has been dedicated towards implementing software solutions in the context of electromechanical and biological systems. Looking to contribute towards medical-focused research and development.

## EDUCATION

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**University of California, San Diego**

September 2019 - June 2023

Bachelor of Science in Bioengineering, GPA 3.939

*San Diego, CA*

## SKILLS

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**Hardware:** Arduino, 3D Printing.

**Software:** Python, MATLAB, Bash (Linux Shell Scripting), SOLIDWORKS.

**Tools:** Pandas, NumPy, SciPy, Matplotlib, Seaborn, SciKit-Learn, OpenCV, Tensorflow.

**Professional Organizations:** Institute of Electrical and Electronics Engineers (IEEE), Biomedical Engineering Society (BMES), Tau Beta Pi (TBP).

**Relevant Coursework:** Statistical Learning, Introduction to Machine Learning, Biosystems and Control, Principles of Bioinstrumentation Design, Computational Methods in Engineering.

## RESEARCH EXPERIENCE

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**Talke Biomedical Device Lab**

December 2021 - Present

Research Lead

*San Diego, CA*

- Worked with Dr. Frank Talke and Dr. Farshad Ahadian, MD on the implementation of augmented reality with skin biomarkers in minimally invasive surgery.
- Used ArUco markers to enable tracking of surgical instruments in real-time through OpenCV in Python. Position tracking coordinates of markers were exported and post-processed in MATLAB. Currently interfacing positional coordinates with 3D homography to facilitate MRI mapping.
- Improved accuracy of marker tracking system using linear Kalman filtering. Exploring other digital filtering techniques such as using a weighted mean average on the velocities of the marker movements.
- Applied for the **Galvanizing Engineering in Medicine (GEM)** grant and received 10K in funding.

**Swartz Center of Computational Neuroscience (SCCN)**

March 2021 - Present

Undergraduate Researcher

*San Diego, CA*

- Worked with postdoc Chiyuan Chang and Dr. Tzyy-Ping Jung in EEG-based classification experiments. Collaborated with Microsoft's Human Factors team to conduct machine learning analysis of EEG recordings in Python when compared against subjects' respective stress levels in resting and stressful classroom settings.
- Used MATLAB with EEGLAB to export different EEG channels and their signals. Signals were processed in Python to perform Principal Component Analysis (PCA) and Synthetic Minority Oversampling Technique (SMOTE) to respective datasets using the RandomForest algorithm.
- Improved classification of stress vs. non-stress groups by 42.1% in correlation with physiological features. Found statistical significance in the asymmetry of EEG channel pairings.

## WORK EXPERIENCE

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**Johnson & Johnson**

June 2022 - August 2022

Instruments R&D Intern

*Redwood City, CA*

- Interned at Auris Health, Johnson and Johnson's flexible robotics division for minimally invasive surgery of urology. Supported design validation clinical trials through preparation and sterilization of instrument kits.
- Performed root cause analysis on the failure of instrument devices. Designed near-infrared camera system for optical calibration in endoscopes.
- Supported manufacturing efforts and systems investigations towards optical calibration stations and instrumentation platforms.

## TEACHING EXPERIENCE

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### Instructional Assistant

December 2020 - March 2021

- Worked as an IA for BENG 1, an introductory Bioengineering lab course, under Dr. Robert Sah. Oversaw two lab sections of 30 students each.
- Trained students in the fundamentals of Bioengineering. Topics taught included biomechanics, noninvasive cardiovascular sensing, and spine segmentation.

## PUBLICATIONS

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**Tsui, D.**, Khedkar, A., Jung, T., “Detection of subjective stress using asymmetry-based EEG recordings in students”, *2023 45th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, in progress.

**Tsui, D.**, Jo, M., Nguyen, B., Ahadian, F., Talke, F., “Design of a surgical navigation system via positional tracking of fiducial markers”, *Journal of Advanced Mechanical Design, Systems, and Manufacturing*, under review.

## PRESENTATIONS

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“Surgical Site Localization With Non-Invasive Skin Markers for Pain Management”, Center for Memory and Recording Research (CMRR) Research Review, December 2022.

“Surgical Site Localization Through Augmented Reality Assisted Navigation”, 2022 JSME-IIP/ASME-ISPS Joint Conference on Micromechatronics for Information and Precision Equipment, August 2022.

“Implementation of a Telesurgical/Prosthetic Hand”, Bioengineering Day at UC San Diego, April 2022.

## PROJECTS

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### Statistical Learning of Virus Detection with Nanosensor

March 2022 - Present

- Capstone project under the supervision of Dr. Gert Cauwenberghs working on the implementation of supervised machine learning to detect traces of viruses in a graphene field-effect transistor (GFET).
- Designing a machine-learning pipeline that takes in current-voltage data from the GFET and classifies the data as a particular virus biosample.
- Performed optimization testing in biosamples to determine effective voltage-current parameters towards reducing power and improving sensitivity.

### Telesurgical Prosthetic Hand

March 2020 - June 2022

- Led team of 20 undergraduates in designing a telesurgical prosthetic hand. Hand designs were formulated and constructed based on biomechanics principles.
- Held workshops in CAD, Arduino, and circuit design. Implemented robotic motion in Arduino and interfaced linear actuators.

### Motor Imagery Classification

January 2022 - March 2022

- Performed binary classification analysis on motor imagery using a BCI competition dataset. Identified subjects' motor visualization using EEG.
- Pre-processed data using CSP, then ran LDA, SVM, and KNN machine learning algorithms to determine the highest accuracy algorithm. Left hand-right hand classification proved to have the highest accuracy.

## LEADERSHIP

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### President

May 2022 - Present

IEEE at UCSD

San Diego, CA

- Overseeing operations for a 300+ student body. Partnered with the San Diego Supercomputing Center (SDSC) to co-found IEEE's Supercomputing Team.
- Hosted lab recruiting talks and technical seminars targeted towards first and second-years looking to get into research. Topics included research in artificial intelligence, robotics, and wearable sensors.
- Awarded the Outstanding IEEE Large Student Branch award for maintaining strong project activities and company relations during tenure.