Haozhe Tian

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Personal Website

Pattern Recognition | Computer Vision | Machine Learning | Signal Processing

Education

- **Beihang University** — Beijing, China
  Bachelor of Engineering GPA: 3.844/4.0 (Top 10%) 2^{nd} in class *Sep 2017 - Jun 2021*
  Pattern Recognition and Control Science, Automation

  Courses: *Linear Algebra | Mathematical Analysis | Complex Functions and Integral Transform | Probability and Statistics | Microprocessor and Interface | Principles of Automatic Control | Digital Signal Processing | Nonlinear Control | Pattern Recognition and Intelligent Systems | Visual Measurement and Applications | Introduction to Robotics | etc.*

  Prizes: China National Scholarship (0.2%) | Three times Outstanding Student Award (5%) | Outstanding Graduate (10%)

- **Imperial College London** — London, UK
  Master of Science Distinction project: 81% *Oct 2021 - Oct 2022*
  Communications and Signal Processing

  Courses: *Information Theory | Coding Theory | Probability and Stochastic Processes | Digital Image Processing | Computer Vision and Pattern Recognition | Adaptive Signal Processing and Machine Intelligence | Wavelet and Representation Learning | Advanced Communication Theory*

  Prize: The Ivor Tupper Prize for "*Excellence in Signal Processing, Broadcast and Video Technology*" (one in the cohort)

Work

- **Research Assistant** — The Hong Kong Polytechnic University
  Privacy for Graph Neural Networks *Jan 2023 - Aug 2023*

Publications

- **Instrumentation of Surface Plasmon Microscopy: Complete Scheme of Signal Extractions**: B. Zhang (supervisor), H. Tian, T. Xiao and J. Zhang, in IEEE Transactions on Instrumentation and Measurement, vol. 70, pp. 1-10, 2021, Art no. 7003710, doi: 10.1109/TIM.2021.3072137.
- **Assembly and Error Analysis of Back Focal Plane-typed Apertometer**: C. Zhang, H. Tian, and B. Zhang, Proc. SPIE 11717, 24th National Laser Conference & Fifteenth National Conference on Laser Technology and Optoelectronics, 117171Y (2 December 2020); https://doi.org/10.1117/12.2587151.
- **Hearables: Heart Rate Variability from Ear Electrocardiogram and Photoplethysmogram (Ear-ECG and Ear-PPG)**: H. Tian, E Occhipinti, and DP Mandic, ***Submitted to EMBC 2023***.

Skills

- **English**: GRE General (330+4.0) | TOEFL iBT (115)
- **Languages**: Python | MATLAB | Simulink | julia | C/C++ | Verilog HDL
- **Frameworks**: Numpy | PyTorch | Scikit-learn | OpenCV | pandas | Matplotlib
- **Others**: LaTeX | html | CSS | git

Research

- **Surface Plasmon Microscopy Based on Object Detection Networks** — Beihang University
  Supervisor: Dr. Bei Zhang (in cooperation with Prof. Michael Somekh) *May 2020 - Apr 2021*

  This work aimed to automatically measure the excitation angles of MgO samples using images acquired in Surface Plasmon Microscopy (SPM). The proposed scheme contains two stages: i) deep learning for polarization state classification and RoI determination, and ii) self-correlation for center identification and gray-scale statistics for radius measurement. The scheme automatized back focal plane SPM and achieved state-of-the-art accuracy.

  - **Instrumentation**: Built an SPM system and acquired surface plasmon (SP) profiles.
  - **Object Detection Network**: Trained a Faster R-CNN network for classifying polarization modes and localizing SP profiles (the first time deep-learning was applied to back focal plane SPM, to our best knowledge).
  - **SP Radius Measurements**: Proposed self-correlation for center identification; Gray-scale statistics for the measurement of SP and aperture's radii.

- **Verification**: Applied the complete algorithm to measure the excitation angle of MgO; bench-marked the model against traditional approaches based on Hough transform and Fourier correlation analysis; compared the performance of several object detection networks (YOLO, SSD, Faster R-CNN).

- **Epileptic Seizure Detection Based on Graph Neural Network** Beihang University
  Supervisor: Prof. Yang Li *Jan 2021 - Jun 2021*

  This work aimed to exploit prior knowledge of the electroencephalogram (EEG) recording configuration. Instead of treating multi-channel EEG as individual signals, this work designed a graph representation of channel connectivity. EEG features on the graph were processed by Graph Neural Network (GNN) for epileptic seizure detection. Comparison with fully connected neural networks proved the introduction of domain knowledge improved model performance.

  - **Data Preparation**: Performed data cleansing on the MIT-CHB data set, identified key EEG frequency bands corresponding to brain waves, and used the power within 8 frequency bands as features.
  - **Adjacency Matrix**: Constructed adjacency matrix using spatial and spectral coherence between EEG channels; the spatial coherence was based on geodesic distance; the spectral coherence was based on normalized cross-spectral density.
  - **Graph Neural Network**: Trained, validated, and tested the performance of the fully connected neural network, shallow GNN, and deep GNN; Quantitatively compared the models using multiple performance metrics (precision, recall, AUC, etc.) to address the class imbalance problem.

- **Heart Rate Variability (HRV) from Ear ECG and PPG** Imperial College London
  Supervisor: Prof. Danilo Mandic *Jan 2022 - (ongoing)*

  This work aimed to extract physically meaningful features from Ear Electrocardiogram (ECG) and Photoplethysmography (PPG). Ear measurement does not hamper subjects' movements, therefore is ideal for long-term health monitoring. However, ear signals have lower SNR. Therefore, this work proposed novel methods for extracting robust features. This work i) identified key features for HRV classification, ii) proved the benefits of using the combined information of ECG and PPG, and iii) showed the feasibility of using ear ECG and PPG for HRV monitoring.

  - **Protocol Design**: Designed an interactive recording protocol guided by interactive app. The protocol was used to record data from 10 real-life subjects
  - **Feature Extraction**: Used matched filter and Hilbert transform to identify ECG R-peaks; estimated time- and frequency-domain HRV features; estimated breathing rate and blood oxygen saturation from PPG; estimated blood pressure using pulse arrival time.
  - **Classification**: Classified physical states using random forest, support vector machine, and naive Bayes classier; compared the significance of different features using two methods: 1) permutation feature importance, and 2) classifiers were cross-validated using different combinations of features.

Activities

- **Student Representative** Promoted Beihang University to 1K+ high-school students and their parents.
- **Vice Minister of College Union** In charge of visual design (logos and posters for college events) of Shoue College, Beihang. Extensively used Adobe Premier, Lightroom, and Photoshop.