

ZHONG XIAOCONG

A joint Ph.D. student with external funding (CSC scholarship)

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📍 School of Instrumentation Science and Engineering, Harbin Institute of Technology, Harbin, China

EDUCATION

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| Harbin Institute of Technology <i>Ph.D. student in Instrument Science and Technology</i> | Sep. 2022 - Present <i>Harbin, China</i> |
| Harbin Institute of Technology <i>M.Sc. in Instrument Science and Technology</i> | Sep. 2020 - Sep. 2022 <i>Harbin, China</i> |
| Harbin Institute of Technology <i>B.S. in Measurement and Control Technology and Instruments</i> | Aug. 2016 - Sep. 2020 <i>Harbin, China</i> |

RESEARCH INTEREST

Brain-Computer Interface (BCI), Biomedical Signal Processing and Control, Rehabilitation Engineering

PUBLICATIONS

- [J1] **Zhong X C**, Wang Q, Liu D, et al. A deep domain adaptation framework with correlation alignment for EEG-based motor imagery classification[J]. *Computers in Biology and Medicine*, 2023, 163: 107235.
- [J2] **Zhong X C**, Wang Q, Liu D, et al. EEG-DG: A multi-source domain generalization framework for motor imagery EEG classification[J]. *IEEE Journal of Biomedical and Health Informatics*. (Under Review, arXiv preprint)
- [C1] **Zhong X C**, Wang Q, Liu D, et al. sEMG signal Detection and cross-individual gesture recognition using easy transfer learning. *2021-2022 China Biomedical Engineering Conference and Medical Innovation Summit*, 2022.
- [C2] **Zhong X C**, Wang Q, Liu D, et al. A feature fusion method for EEG-sEMG signals based on GA-SVM. *2023 China Biomedical Engineering Conference and Medical Innovation Summit*, 2023. (Oral Presentation)

PATENTS

- [P1] **Zhong Xiaocong**, Wang Qisong, Liu Dan, et al. Rehabilitation training system for hand function recovery in hemiplegic patients[P]. Heilongjiang Province: CN116942467A, July 11, 2023.
- [P2] **Zhong Xiaocong**, Wang Qisong, Liu Dan, et al. Adaptive classification method for motor imagery EEG signals with correlation alignment[P]. Heilongjiang Province: CN115640539A, January 24, 2023.
- [P3] Wang Qisong, Liu Dan, **Zhong Xiaocong**, et al. Full-cycle upper limb rehabilitation training device for post-stroke patients[P]. Heilongjiang Province: CN116869777A, July 25, 2023.
- [P4] Wang Qisong, Liu Dan, **Zhong Xiaocong**, et al. Hand gesture recognition method for sEMG signals based on dynamic threshold and EasyTL[P]. Heilongjiang Province: CN114098768A, March 1, 2022.
- [P5] Wang Qisong, Liu Dan, **Zhong Xiaocong**, et al. Gravity compensation method in the compliance control mode of multi-joint diagnostic and therapeutic robot[P]. Heilongjiang Province: CN113319855B, April 12, 2022.
- [P6] Zhang Xiaolin, Hu Yifei, **Zhong Xiaocong**, et al. Automatic detection device and detection method for shrinking pin of aviation electrical connector[P]. Heilongjiang Province: CN110793966B, March 4, 2022.

RESEARCH EXPERIENCE

Research on Voluntary Rehabilitation for Neuromuscular Injuries May. 2023 - Present
(*Research Project funded by the Health Commission of Heilongjiang Province, China*)

We propose a voluntary rehabilitation method for neuromuscular injuries by decoding patients' motor intentions from sEMG signals. Utilizing the decoded motion intentions of the patient to control exoskeleton robots, assisting patients in performing specific rehabilitation movements, and achieving active rehabilitation. Then we develop quantitative indicators for injury/recovery and provide real-time monitoring and feedback to correct patients' rehabilitation training, promoting accelerated recovery of damaged neuromuscular.

- **Role:** Solution design; motor intention decoding; exoskeleton robot control

Development of Full-Cycle Upper Limb Rehabilitation System for Post-stroke Sep. 2022 - Present
(*Harbin Institute of Technology Multidisciplinary Fund Project*)

We investigate the characteristics of post-stroke patients at different pathological stages, then develop an upper limb rehabilitation training system with UR3 robot for post-stroke patients and design the passive, assistive, and active rehabilitation training modes tailored to the flaccid, spastic, and recovery phases, respectively. To address issues such as weak strength and fatigue of patients, we propose an EEG-sEMG feature fusion method based on GA-SVM, effectively improving the classification accuracy of upper limb movements compared to single-mode sEMG signals.

- **Role:** System scheme design; EEG-sEMG fusion algorithm design

Research on Hybrid Brain-Computer Interface based on Transfer Learning Sep. 2021 - Jul. 2022
(*Master's Thesis, Harbin Institute of Technology Student Future Technology Innovation Team Project*)

To address the non-stationarity and inter-individual variation of biomedical signals, we propose an improved transfer learning method based on EasyTL for sEMG classification and a deep domain adaptation framework DDAF-CORAL for end-to-end EEG analysis. Experimental results demonstrate that the proposed methods effectively reduced the feature distribution differences of cross-domain signals, and negative transfer, and enhanced the robustness and generalization ability of source domain models on target domains.

- **Role:** Data acquisition and signal processing; transfer learning algorithm research and implementation

Development of Wearable Rehabilitation Exoskeleton Glove for Post-stroke Jul. 2020 - Jul. 2021
(Harbin Institute of Technology Student Future Technology Innovation Team Project)

We design a multi-channel sEMG signal acquisition device based on ADS1299 and extract time and frequency-domain features of multi-channel signals, ultimately achieving high-precision and online hand gesture recognition for healthy users. Furthermore, a flexible wearable rehabilitation exoskeleton glove is designed to facilitate contralateral hand rehabilitation training, which can provide efficient rehabilitation for hemiplegic post-stroke patients.

- **Role:** Matlab signal processing; hardware circuit design; embedded programming

HONORS AND AWARDS (IN THE RECENT 3 YEARS)

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| Excellent Student Title - Harbin Institute of Technology | Oct. 2023 |
| The Second Prize - The 18th National Graduate Electronic Design Competition in China | Aug. 2023 |
| Young Excellent Paper - China Biomedical Engineering Conference and Medical Innovation Summit | May. 2023 |
| Excellent Cases of Research Instruments - China Association for Science and Technology (CAST) | Mar. 2023 |
| The Second Prize - The 10th National College Student Photonics Design Competition in China | Aug. 2022 |
| Outstanding Graduate Title and Outstanding Master's Thesis - Harbin Institute of Technology | Jun. 2022 |
| National Scholarship - Ministry of Education of China | Oct. 2021 |
| The First-Class Academic Scholarship - Harbin Institute of Technology | Sep. 2021 |
| The Second Prize - The 16th National Graduate Electronic Design Competition in China | Aug. 2021 |

SKILL HIGHLIGHTS

Professional Skills:

- Python/PyTorch for deep learning
- Matlab for signal processing
- C++ for embedded systems programming
- SolidWorks for mechanical modeling
- Multisim for circuit simulation

Language Proficiency:

- Chinese (Native), English (Fluent)

EXTRA CURRICULAR ACTIVITIES

- Volunteer work with special needs students
- Table tennis, basketball, swimming, and skiing/snowboarding