Yonghao Song

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Education

South China University of Technology Guangzhou, China
Master student of Control Science and Engineering *Sep. 2019 – Jun. 2022*

- Advisor: Prof. Longhan Xie
- First-class scholarship (2019, 2020)

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences Shenzhen, China
Research Assistant at Center of Human-Computer Interaction *Jul. 2021 – Jun. 2022*

- Advisor: Prof. Pheng Ann Heng & Dr. Qingqing Zheng

South China University of Technology Guangzhou, China
Bachelor of Information Engineering - Experimental Class *Sep. 2015 – Jul. 2019*

- GPA: 3.26/4.0, won postgraduate recommendation (for Top 25%)

Objective

Looking for a Ph.D. position on EEG analysis of motor intention and assistant exoskeleton control.

Research Experience

Electroencephalograph (EEG) Signal Analysis and Deep Learning

*** Global Adaptive Transformer for Cross-Subject EEG Classification** *July. 2021 – present*

- Put forward an algorithm to alleviate the impact of individual differences in cross-subject EEG classification, by adaptively transforming the global temporal feature of subject-specific data to subject-independent data [1].

*** Transformer-based EEG Decoding** *Mar. 2021 – Jun. 2021*

- Proposed a novel EEG decoding method that mainly relies on the attention mechanism. The spatial and temporal features were well learned by attention transformation. And we achieved leading results with fewer parameters [2].

*** Joint Spatial and Temporal Feature Extraction with CNNs** *Dec. 2020 – Mar. 2021*

- Designed a convolutional neural network (CNN)-based spatial-temporal analysis network to extract discriminative spatial and temporal features and classify different categories of EEG in an end-to-end process [3].

*** Common Spatial GANs for EEG Data Augmentation** *Jun. 2020 – Feb. 2021*

- Present a generative adversarial network (GAN) that enhanced the spatial features for high-quality EEG signal generating. It could be used to improve the cross-subject performance of EEG classification by augmenting data [4].

Discriminative Feature Training Strategy for Motor Imagery Classification *May. 2020 – Jan. 2021*

- Developed a strategy that clusters EEG samples to the central vector of each class during training CNNs [5].
- Used adversarial learning to separate class-related and class-independent features for better EEG classification [6].

Auditory Attention Detection with Spatial Analysis of EEG Signals *Feb. 2020 – May. 2020*

- Applied common spatial pattern to enhance the EEG discrimination between different auditory attention, which greatly improved the detection performance under three different levels of noise environment [7].

Application of Transfer Entropy Model in EEG and EMG Signals *Dec. 2018 – May. 2019*

- Bachelor's thesis.
- Realized the calculation of transfer entropy and probability estimation to measure the coupling of EEG and EMG.

Brain-Computer Interface (BCI) and Rehabilitation

*** Unilateral Limb Motor Imagery Classification for Online Control** *Oct. 2020 – Jun. 2021*

- Detected the imageries of moving the arm forward, backward, left, right to control the robot assisting the upper-limb to move the stick to a specific hole on the board, a commonly used rehabilitation tool.

P300 Controls an Upper-Limb Assist Robot *Jun. 2019 – Oct. 2019*

- Controlled an assist robot arm stably with P300 to help the disabled perform multiple upper-limb activities [8].

Assistive Mobile Robot with Shared Control of BCI and Computer Vision *Oct. 2019 – Dec. 2019*

- Employed P300 signals to obtain user's intention of an object and object recognition to provide 3D coordinates, to cooperate with a mobile platform equipped with a radar for obstacle avoidance and a robot arm for grasp [9].

Computer Vision

Mainly conducted some experiments and improvements.

Feature Separation GANs for Facial Expression Recognition *May. 2019 – Feb. 2020*

- Proposed a GAN framework that exchanges partial facial features of two samples in the generator, and separated expression-related and expression-independent features with adversarial training. Expression-related features were used for recognition and achieved better accuracy, the influence of individual differences was also reduced [10, 11].

Facial Age Estimation *Apr. 2017 – Feb. 2018*

- Used CNNs to identify the age with a label encoding method introducing the correlation between adjacent ages.

Projects, Competitions, and Activities

*** BCI Competition of World Robot Contest** *Jun. 2021 – Present*

- Finalist for total scores (Top 14 teams)
- Rank Top 2 in motor imagery and Top 10 in emotion BCI.

"Climbing" Program of South China University of Technology *Jan. 2018 – Nov. 2018*

- Completed a facial expression recognition system using Mask-RCNN to bound the facial area.

Synthetic Design of Electronic System *Mar. 2018 – Jun. 2018*

- Developed an intelligent camera with the function of recognizing objects and automatically tracking targets.

China Undergraduate Mathematical Contest in Modeling *Sep. 2017 – Oct. 2017*

- The First Prize in Guangdong Province.
- Designed a pricing plan for different tasks under the influence of multiple factors with the clustering method, and established a task classification scheme based on support vector machines.

Skyworth Technology Club - iOS group *Nov. 2016 – Jun. 2017*

- Wrote a mobile application using Objective-C language for students to make friends, with many functions.

Skills

English: IELTS - 6.5 (Reading 8, Writing 6), CET-6 - 509
EEG and EMG Collection: Brain Products (Amplifier, Recorder, Analyzer)
Programming languages: Python, MATLAB, LaTeX, Git, C++
Deep Learning Tools: PyTorch, TensorFlow, Keras

Others

Teaching Assistant: College English and Academic English (Excellent TA) Spring 2021
Reviewer: *Journal of Neural Engineering*

Publications

[1] **Y. Song**, Q. Zheng, L. Xie, and P. Heng, "Adapt: Global adaptive transformer for cross-subject EEG classification," *(in preparation)*.

[2] **Y. Song**, X. Jia, L. Yang, and L. Xie, "Transformer-based spatial-temporal feature learning for EEG decoding," *IEEE Transactions on Cybernetics (under review), https://arxiv.org/abs/2106.11170*, 2021.

[3] X. Jia*, **Y. Song***, L. Yang, and L. Xie, "Joint spatial and temporal features extraction for multi-classification of motor imagery EEG," *Biomedical Signal Processing and Control*, 2021.

[4] **Y. Song**, L. Yang, X. Jia, and L. Xie, "Common spatial generative adversarial networks based EEG data augmentation for cross-subject brain-computer interface," *https://arxiv.org/abs/2102.04456*, 2021.

[5] L. Yang, **Y. Song**, K. Ma, and L. Xie, "Motor imagery EEG decoding method based on a discriminative feature learning strategy," *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 2021.

[6] L. Yang, **Y. Song**, K. Ma, E. Su, and L. Xie, "A novel motor imagery EEG decoding method based on feature separation," *Journal of Neural Engineering*, 2021.

[7] S. Cai, E. Su, **Y. Song**, L. Xie, and H. Li, "Low latency auditory attention detection with common spatial pattern analysis of EEG signals," in *Proc. Interspeech*, 2020.

[8] **Y. Song**, S. Cai, L. Yang, G. Li, and L. Xie, "A practical EEG-based human-machine interface to online control an upper-limb assist robot," *Frontiers in Neurorobotics*, 2020.

[9] **Y. Song**, W. Wu, C. Lin, G. Lin, G. Li, and L. Xie, "Assistive mobile robot with shared control of brain-machine interface and computer vision," in *IEEE 4th Information Technology, Networking, Electronic and Automation Control Conference (ITNEC)*, 2020.

[10] L. Yang, **Y. Song**, Y. Tian, G. Hu, and L. Xie, "Feature separation generative adversarial network for facial expression recognition," *under review*, 2020.

[11] L. Yang, Y. Tian, **Y. Song**, N. Yang, and L. Xie, "A novel feature separation model exchange-gan for facial expression recognition," *Knowledge-Based Systems*, 2020.

[12] L. Yang, G. Hu, **Y. Song**, G. Li, and L. Xie, "Intelligent video analysis: a pedestrian trajectory extraction method for the whole indoor space without blind areas," *Computer Vision and Image Understanding*, 2020.