Yongcheng Li

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ENDUCATION

09/2009- 01/2016 **Ph. D** **Pattern Recognition and Intelligent Systems**

Chinese Academy of Science (CAS)

09/2005 - 06/2009 **B. Eng.** **Control Theory and Control Engineering (Major)**

B. B. A. **Business Administration (Minor)**

University of Science and Technology of China (USTC)

WORK EXPERIENCE

09/2017-present **Postdoc.**

Department of Neurology, University of California, Irvine, USA

04/2016-04/2017 **Research Fellow (Postdoc.)**

Department of Biomedical Engineering, National University of Singapore, Singapore

PROFESSIONAL INTERESTS

Brain-machine Interface for rehabilitation; Neural Prosthetics; Dissociated Neural Network Interface; Machine Learning; Data Analytics; Artificial Intelligence; Neural Signal Processing; Neural Cognitive Process and Rehabilitation

RESEARCH EXPERIENCE

- **Designing brain machine interfaces (BCI) to enhance recovery after brain injury** **09/2017 – present**

  (Department of Neurology, University of California, Irvine, USA)

  Based on the designed brain machine interface, develop the strategies to drive plasticity and enhance the recovery of traumatic brain injury (TBI) patients with hemicraniectomy. In this project, an effective ICA-based artifacts removal algorithm was developed to remove the EMG from EEG, thus high gamma (70 Hz – 110 Hz) signal from EEG was confidently used to decode the movement parameters. Combining with haptic feedback system, the designed BCI is applied to clinical trials of TBI patients rehabilitation, and finally is validated on more than 20 TBI patients.

  1) Designed and executed the experiments on TBI patients
  2) EEG signal processing (EMG artifacts rejection, mapping between EEG and movement, decoder building)
  3) Developed the software for brain machine interface (BCI 2000, Matlab)

4) Developed the haptic feedback system

- **Designing a wearable analogue of bi-directional - BCI system for chronic spinal cord injury patients 09/2017 – present (Department of Neurology, University of California, Irvine, USA)**

  Develop a wearable analogue of bi-directional – BCI system, which can decode the ECoG data from motor cortex to command the low limb exoskeleton and convert the leg movement to artifact electrical stimulation for sensory cortex in order to recover the movement and sensation of chronic spinal cord injury patients

  1) Executed the walking experiments and collected the ECoG data
  2) Investigated the motor decoding algorithm based on ECoG
  3) Developed system prototype (recording ECoG data and decoding movement from ECoG in real time)
  4) Developed system to detect the gait events by single IMU
  5) Developed the control strategies for low limb exoskeleton

- **Feasibility of engineered neural network as a novel post-stroke neurorestorative technology 09/2018 – present (Department of Neurology, University of California, Irvine, USA)**

  Based on the developed and validated engineered cultured neural network (CNN) derived from human induced pluripotent stem cells (HIPSCs), develop the whole system (including software and hardware) to train the CNN to functionally recognize the signal from human motor cortex

  1) Designed and executed all the protocols for differentiating the HIPSCs to neurons
  2) Developed the electrical stimulation algorithm for neural network training
  3) Designed the EEG experiments for cultured neural network training
  4) Developed microfluidic device for patterned neural network

- **Studies of motor learning mechanism with exoskeleton robots assistant 04/2016 - 04/2017**

  (Department of Biomedical Engineering, National University of Singapore, Singapore)

  Based on utilization of the lower limb exoskeleton robots, develop experiments to study the motor learning rules in healthy subjects and patients

  1) Theoretical proof and experiments design for the basic hypothesis
  2) Developed GUI providing the motor learning strategy (using LABVIEW)
  3) Developed vibration device providing the tactus (using ardiuno microcontroller)
  4) Investigated the influence of biofeedback on motor learning by the lower limb exoskeleton robots
  5) Collected data from the post-stroke patients who used the lower limb exoskeleton robots

- **Development of The Biological-brain Robot （PH.D thesis） 03/2011-12/2015**

(State Key Lab. of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences)

Developed a closed-loop mobile robot system for the first time using a controller with the highly hierarchical cultured neural network.

Biological Experiments

1) Theoretical proof in biological and engineering architecture, and experiments design for the whole system
2) Based on the similarity function, developed the pattern recognition algorithm to identify the spatiotemporal motifs of reverberation
3) Investigated the characteristics of the spatiotemporal pattern of reverberation evoked by electrical stimulus to demonstrate the Hebbian plasticity in the cultured neural network.

Engineering Development

1) Based on the ARM cortex M3, designed and developed the stimulation generator employed for the cultured neural network
2) Developed the binomial and the spatiotemporal encoding/coding algorithms to process the signal from cultured neural network (online)
3) Developed the robot vision algorithm based on the color feature space to identify the position of robots
4) Developed a robot control GUI merging the function of the robot vision (using the MFC in Windows OS)
5) Developed a toolbox including some algorithms of the signal processing and decoding/coding algorithms for processing the neural network's signal (Linux)
6) Accomplished the neuro-robot hybrid system via merging the robot control system with the neural signal processing platform

- **Development of an Intelligent Mobile Robot for Middle Size Robot League** **01/2008-05/2009**

(Department of Automation, University of Science and Technology of China)

Developed an intelligent mobile robot with the robot vision and ability of high-speed movement for the middle size robot league.

GRANT

Principal Participator, NIH R01: Designing brain machine interfaces to drive plasticity and enhance recovery after brain injury. NIH (RNS094748A),10/01/2015-9/30/2020, Total cost: $2,806,112

Principal Participator, Collaborative Research: A Bi-Directional Brain-Computer Interface for Restoration of Walking and Lower Extremity Sensation after Spinal Cord Injury. NSF (1646275), 01/09/2018-08/31/2023, Total cost: $8,000,000

Principal Participator, UC Irvine Seed Grant Program: Feasibility of Engineered Neural Network as a Novel Post-Stroke

Neurorestorative Technology, University of California, Irvine, 8/1/19-7/30/20, Total cost: $10,112

Principal Participator, "Investigation of Neuro-robot System Controlled via Using the Dissociated Neural Network", Foundation of State Key Laboratory of Robotics, Shenyang, China, 1/1/2012 – 12/31/2014, Total cost: ￥1,000,000

Other Grants (mentored students):

Co-mentor, Design of a portable BCI device utilizing microcontroller, (student: Xiecheng (Arthur) Shao), Undergraduate Research Opportunities Program, 06/2018 - 06/2019, $2000.

SELECTED PUBLICATIONS & PRESENTATION

Journal Papers

（1） **Yongcheng Li**, Po T. Wang, Mukta P. Vaidya, Charles Y. Liu, Marc W. Slutzky and An H. Do, "Electromyogram (EMG) Removal by Adding Sources of EMG (ERASE) - A novel ICA-based algorithm for removing myoelectric artifacts from EEG", *Frontier in neuroscience,* 2021, 1, pp.1214

（2） **Yongcheng Li**, Po T. Wang, Mukta P. Vaidya, Robert D Flint, Charles Y. Liu, Marc W. Slutzky and An H. Do, "Refinement of High-Gamma EEG Features From TBI Patients With Hemicraniectomy Using an ICA Informed by Simulated Myoelectric Artifacts", *Frontier in neuroscience,*2020, 14, pp.1214

（3） **Yongcheng Li**, Rong Sun, Yuechao Wang, Hongyi Li, and Xiongfei Zheng, "A Novel Robot System Integrating Biological and Mechanical Intelligence Based on Dissociated Neural Network-Controlled Closed-Loop Environment". *PLoS ONE*, 2016, 11(11): e0165600.

（4） **Yongcheng Li**, Rong Sun, Bin Zhang, Yuechao Wang, and Hongyi Li, "Application of hierarchical dissociated neural network in closed-loop hybrid system integrating biological and mechanical intelligence," *PLoS ONE*, 2015, 10, e0127452

（5） **Yongcheng Li**, Hongyi Li, Guoqiang Bi and Yuechao Wang, "A Multichannel Waveform Generator for Spatiotemporal Stimulation of Dissociated Neuronal Network on MEA", *Journal of Medical and Bioengineering*, 2015, 4 (2), pp. 105-109

（6） Vaidya M, Flint RD, Wang PT, Barry A, **Li Y.C**, Ghassemi M, Tomic G, Yao J, Carmona C, Mugler EM, Gallick S. "Hemicraniectomy in traumatic brain injury: a noninvasive platform to investigate high gamma activity for brain machine interfaces". *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. 2019

（7） Wang PT, Camacho E, Wang M, **Li Y.C**, Shaw SJ, Armacost M, Gong H, Kramer DR, Lee B, Andersen RA, Liu CY. "A benchtop system to assess the feasibility of a fully independent and implantable brain-machine interface". *Journal of neural engineering*. 2019

（8） Yunfa Fu, Xin Xiong, Changhao Jiang, Baolei Xu, **Yongcheng Li**, and Hongyi Li. Imagined Hand Clenching Force and Speed Modulate Brain Activity are Classified by NIRS Combined with EEG. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 2016, pp (99), pp. 1-1.

（9） Yunfa Fu, Baolei xu**, Yongcheng Li,** Yuechao Wang, Zhengtao Yu, Hongyi Li, **"**Single-trial decoding of imagined grip force parameters involving the right or left hand based on movement-related cortical potentials", *Chinese Science Bulletin*, 2014, 59, pp 1907-1916

（10） Yunfa Fu, Yuechao Wang, Hongyi Li, Baolei Xu, **Yongcheng Li**. "Direct brain-controlled robot interface technology". *Acta Automatica Sinica*, 2012, 38(8): 1229-1246.

（11） **Yongcheng Li**, Po T. Wang, Liu CY, Zoran Nenadic and An Do, "Spatiotemporal patterns of gamma synchronization in response to different upper extremity movement" *Nature communication* (under review)

Conference Papers

（1）**Y. Li**, P. T. Wang, M. P. Vaidya, C. Y. Liu, M. W. Slutzky, and A. H. Do, "A novel algorithm for removing artifacts from EEG data," *in Engineering in Medicine and Biology Society, EMBC, 2018 Annual International Conference of the IEEE.* July 2018, Honolulu, USA (**oral presentation**)

（2）**Yongcheng Li**, Hongyi Li, and Yuechao Wang ,"Neural-based control of a mobile robot: a test model for merging biological intelligence into mechanical system", *In Proceeding of 7th IEEE Joint International Information Technology and Artificial Intelligence Conference (ITAIC 2014)*, Dec. 2014, Chongqing, China, Vol.1, pp.186-190.

Conference Abstracts

（1） Wei Wu, Lei Qi, **Yongcheng Li**, Pengcheng Zhou, Yi Zhang, Parkmin Lau, and Guoqiang Bi. "Conserved spatiotemporal motifs during evoked reverberation in cultured neuronal networks" Control No. 272.16. 2014 Neuroscience Annual Meeting. Washington, DC: Society for Neuroscience, 2014

Books

（1） Brain–computer interfaces: principles and practice / edited by Jonathan R. Wolpaw, Elizabeth Winter Wolpaw, Published by Oxford University Press, Inc. New York; translated by Yunfa Fu, Baolei Xu, **Yongcheng Li**, published by National Defense Industry Press, Beijing, April 2017

PROFESSIONAL SERVICE AND ACTIVITIES

Journals Served as an Ad-Hoc Reviewer

- Journal of NeuroEngineering and Rehabilitation (JNER), 2018 – present
- Neurocomputing (journal), 2017 – present

Conferences Served as a Reviewer

- Proceedings of the International IEEE Engineering in Medicine and Biology Annual Conference (EMBC), 2018-present
- International Brain Computer Interface Meeting, 2018

ACADEMIC ADVISEES

Masters:

Jen-Shuan Chang, Biomedical Engineering (NUS), role: co-advisor, 06/2016 - 04/2017. Last known position: National University of Singapore.

Undergraduate:

Xiecheng (Arthur) Shao, (UCI Biomedical Engineering), Undergraduate Research Opportunities Program, 6/2018 – 6/2019.

Jonathan Fu, (University of Boston, Medical school), visiting research student, 7/2019

Natalie Ann Tobin, (UCI biological), Undergraduate Research Opportunities Program, 6/2019 – 6/2020.