

National Chiao Tung University

国立交通大学

國意意通大學 腦科學研究中心 Brain Research Center, NCTU



Brain Research Center National Chiao-Tung University Hsinchu, Taiwan

Director: Dr. Chin-Teng Lin http://brc.nctu.edu.tw/



Missions of NCTU BRC



To Integrate MEMS technology, biotechnology, information technology, and cognitive science into basic and applied Neural Engineering research.

Basic Studies

 Investigate underlying neurobiological mechanisms associated with cognitivestate changes (e.g., drowsiness, attention, etc.) and accompanying optimal and suboptimal motor responses in attentiondemanding cognitive tasks involving kinesthetic, visual, auditory stimulus interpretation and decision-making.

Missions of NCTU BRC



- Applied studies
 - To extend the information management capacity of the "human-machine operating integral" for safety and efficiency by enhancing human cognitive ability in diverse and stressful task environments (e.g., Vehicle Driving).
 - To develop adaptive assistant devices or neuroprosthetic devices to provide unobstructed living environments for aging or disableds individuals.

Approaches



- Integrating NBIC (Nano-, Bio-, Info., Cognition) Technologies and using
 - * 3D Virtual-Reality (VR) Surrounded Environment
 - Six Degrees-of-freedom Dynamic Platform
 - Portable Real-time Biomedical Signal Acquisition and Analysis System
 - To pursue combined cognitive neuroscience/engineering research



Organization

Brain Research Center Natural Gain Tay University

Director: Prof. Chin-Teng Lin

International Cooperators: MPIHD: Shu-Chen Li UCSD: Tzyy-Ping Jung, Jeng-Ren Duann, & Ruey-Song Huang

Core Members: J. C. Chiou, K. Y. Yang, S.F. Liang, I.F. Chung, W.C. Lin





Director: Dr. C. T. Lin



Chin-Teng (CT) Lin received Ph.D. degrees in electrical engineering from Purdue University, U.S.A., in 1992. He is currently the Chair Professor of Electrical and Computer Engineering, Dean of Computer Science College, and Director of Brain Research Center at NCTU.

Dr. Lin is an IEEE Fellow for his contributions to biologically inspired information systems. He serves on Board of Governors at IEEE Circuits and Systems (CAS) Society in 2005-2008, and at IEEE Systems, Man, Cybernetics (SMC) Society in 2003-2005. He is the Distinguished Lecturer of IEEE CAS Society from 2003 to 2005.

Dr. Lin currently serves as the Deputy Editor-in-Chief of IEEE Trans. on Circuits and Systems, Part II, AEs of IEEE CAS Part I & Part II, IEEE SMC, IEEE Fuzzy Systems. Dr. Lin is a member of Tau Beta Pi, Eta Kappa Nu, and Phi Kappa Phi honorary societies.

International Institutes and Hospital Collaboration Defense Advanced Research Projects Agency (DARPA) **Research Project (USA):** Development of Dry MEMS Bio-Sensors Cooperation with Swartz Center, INC, UCSD for more than 5 years **50 Billion / 5 Years Grant Project in Taiwan** Nanoelectronics Infotornic Systems Research Center **Bio-inspired Intelligent System Project** National Science Council Grant Project: National Science Council Grant Project: **Bio-Cultural Co-construction of Adaptive** The Develop of Portable EEG Monitoring and **Assistive Technologies and Environments for Brain-Computer-Interface System** Successful Aging (Only 5 Projects are (Only 20 are supported/220 applications) supported each year) Long-term cooperation with Taipei Cooperation with MPI-HD, Berlin more Veterans General Hospital than 2 years Long-term cooperation with Nation Long-term cooperation with Nation Yang-Ming University Yang-Ming University

International Collaborations





Swartz Center for Computational Neuroscience Institute for Neural Computation University of California, San Diego Professor T. P. Jung (鑚き羊博士) Doctor J. R. Duann (食正仁博士)

Dr. Jung and Dr. Duann has been visited NCTU BRC for 3 months in 2006.







International Collaborations



Comparisons with Benchmark Institutes

	Neural Comp. Institute UCSD	Max Planck Institute Berlin	Beckman Institute UIUC
Character- istic	 Famous for Static Bio. Cog. Neuroscience 	 Aging and Cognitive Science Research 	 Start to study VR Static Driving Tasks
BRC Advantage	 World leading Wireless Dry Electrodes 3D VR Dynamic Driving Platform 	 World leading Wireless Dry Electrodes World Leading Information Technologies 	 Camera-based Analysis Behavior Data Plan to Add Dynamic Platform
Develop- ment	 Create Dynamic Cog. Eng. New Research Field 	Develop Adaptive Assistive Tech. for Aging	 Research Results Over 2 Years

Ongoing Research Topics



Real-Time Physiological Signal Acquisition and Analysis System

- Innovative Dry Electrodes
- Bio-Amplifier
- Wireless Transceiver
- Portable Embedded System

Dynamic Stimulus Cognitive Engineering

Driving related Research:

- Cognitive State Estimation System (Drowsiness)
- Single Trial ERP
- Biofeedback
- Motion Sickness
- Dual Task
- Driving Style
- Aging related Research:
 - Spatial Navigation
 - Sensory-motor Coordination
 - Attention/Memory



Research Highlights – MEMS Biosensors



- Self-Stabilization and All-in-one (measuring physiological signals).
- The lowest-cost electrodes (NT\$1500 ---> NT\$10)
- Build-in EEG Amplifier (x10000) and filters (1-100 bandpass)
- Ultra-low-power wireless transmission
- Innovation of on-chip skin/hair compensation system
- ♦ Minimize Size: 2 x 2 mm², 20 × 20 array
- \bullet Good thermal stability (186 $^{\circ}$ C in air)







Drowsiness Estimation – Flowchart













