Engineering scientists design and develop complex systems in medical research

ROBOT-ASSISTED surgery could produce better results than conventional surgery. However, though medical robots have been used in surgeries, they are not used as trainers. Believing that medical robots could also do a better job as trainers, Engineering scientists Dr Chui Chee Kong and Assoc Prof Marcelo Ang, both from the Department of Mechanical Engineering, and Prof Xu Jianxin from Department of Electrical and Computer Engineering are working towards medical robots which can teach and guide trainee surgeons.

Dr Chui, Assoc Prof Ang and Prof Xu in collaboration with a team led by Dr Stephen Chang, Research Director, Division of Hepatopancreatobiliary Surgery, National University Health Service recently received A*STAR's Science and Engineering Research Council (SERC) grant. Their project, *Image-Guided Robot Assisted Surgical Training System* (IRAS) comes under **A*STAR's Assistive Infocomm and Media for Health Monitoring and Rehabilitation (AIM) Programme**.

Dr Chui who is Co-Investigator for the project, said: "We target to design and build robots which can hold and guide a trainee surgeon's hands through procedures in a virtual environment. An analogy would be that of a master calligrapher holding on to his student's hand and guiding him through the execution of various characters."

Assoc Prof Ang, Collaborator for the research, added: "We are also hoping to develop trainer robots that will help surgeons get a sense of touch when training in a virtual environment. We can do this by computing the force of a surgical tool in contact with the tissue, and the reaction of the tissue. This 'sensation' is amplified by the robot and conveyed to the trainees through electronic signals."

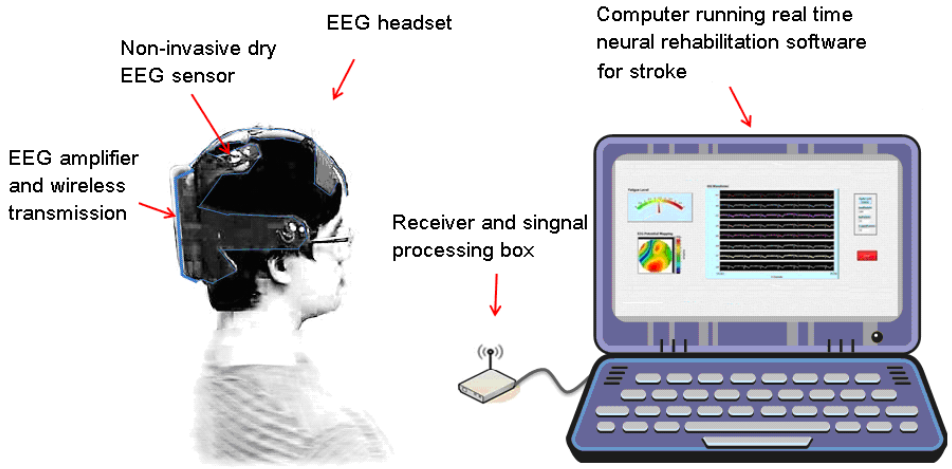
Researchers from the NUS Faculty of Engineering are also working on another project under the AIM Programme -- *Advanced Rehabilitation Therapy for Stroke based on Brain-Computer Interface* (ArtsBCI). Prof Li Xiaoping and Assoc Prof Teo Chee Leong, both from the Department of Mechanical Engineering as well as Assoc Prof Lian Yong, Department of Electrical and Computer Engineering are part of the team led by Dr Guan Cuntai, Programme Manager, Assistive ICM for Health Monitoring and Rehabilitation Programme, Institute for Infocomm Research.

Elaborating on the research which NUS Faculty of Engineering is conducting for this project, Prof Li said, "We are developing the headset for the patients. This headset will have innovative dry EEG sensors embedded to detect brain signals, as compared to the conventional method of EEG signal acquisition which requires wet electrodes."

Prof Li explained that the method using wet electrodes has a few problems -- firstly, conductive gel has to be applied at the location where the electrode comes in contact with the scalp and rubbed with cotton wool to enable an electrically conductive interface. This takes about 30 to 60 minutes before EEG measurement can begin. Secondly, fresh

gel will have to be re-applied if the EEG measurement takes longer than two hours, and lastly, patients have to wash their hair after EEG measurement.

“These problems will totally disappear when our non-invasive dry EEG sensor is used,” Prof Li added.



Stroke sometimes called an acute cerebrovascular attack, is due to disturbance of in the blood supply to the brain. As a result, the affected area of the brain is unable to function, leading to disabilities. Often the road to recovery is long and the cost in health care a major concern for these patients. Through ArtsBCI, the team hopes to shorten the rehabilitation period and hence lower health cost required by such patients.

The system when completed will help in the rehabilitation of stroke victims, helping them to regain the functions they have lost after a seizure. Said Prof Li, “The human brain has a large capacity of neurons which are not used. These neurons could be stimulated by electronic signals to carry on the work of neurons which have been destroyed due to stroke.”

Last year, the BCI team at Institute for Infocomm Research led by Dr Guan won first place in the worldwide BCI Competition IV in all three electroencephalogram (EEG) based non-invasive BCI categories. They designed the non-invasive BCI technology to provide a channel for direct communication between the human brain and the computer, so that physically handicapped individuals and those who have lost effective communication and interactive abilities, are able to communicate and interact with their environment through thoughts.