Dear Colleagues

Institute of Complex Medical Engineering (ICME) is a nonprofit organization established in 2005 by gathering the multidisciplinary researchers in Medical, Engineering and associated fields. Since 2005, the ICME has held annual conferences or symposiums all over the world. It is a great pleasure to welcome you to the 14th ICME International Conference on Complex Medical Engineering (CME 2020) at Takamatsu, Kagawa prefecture, Japan. The objective of CME 2020 is to provide a forum for researchers, educators, engineers, clinicians, medical staffs and government officials involved in the general areas of biomedical engineering to disseminate their latest research results and exchange views on the future research directions of these fields. In addition to this principal object, we will plan an anniversary project consisting of the 15th anniversary lecture and issue of the founding ICME to commemorate that 15 years passed from the founding of ICME in 2020. We hope that this conference proves to be a very rewarding and valuable meeting to bridge from the past to the next step of ICME.

I am looking forward to the participation of all researchers and deeply hope that through everyone's cooperation, this meeting succeeds and helps mark our era.

Thank you.

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Tremors: Different instabilities of motor control

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The human motor control system is optimized for accuracy in making movements. The motor command issues correlative feedforward signals to the brain indicating the intended movement and the sensory systems provide feedback to the brain indicating the actual movement. Mismatch of feedforward and feedback leads to modification in command to improve accuracy. The cerebellum acts as the main center for this important process, and when the cerebellum is not functioning properly inaccurate movements and tremor might result. It is not a surprise that virtually all tremors of central origin seem to arise from instability in the cortico-cerebello-thalamo-cortical loop (CCTC). The relevant thalamic nucleus in this circuit is the ventral intermediate nucleus (VIM), and surgical lesions or deep brain stimulation (DBS) of the VIM can markedly reduce the amplitude of most tremors. However, it is clear that different tremors look and behave differently, so the way in which they engage the CCTC must differ.

The most common tremor (classic) tremor of Parkinson disease (PD) is present at rest, usually disappears briefly when the limb goes into a posture, and then returns in what is called re-emergent tremor. During kinetic action it is often not present. The movement disorder of PD arises from basal ganglia dysfunction and recordings from neurons in the basal ganglia show oscillations at tremor frequency correlating with the limb tremor and also excessive oscillations at beta frequency correlating with "stability" – that is, rest or stable posture. Both tremor frequency and beta frequency behavior disappear with movement. The basal ganglia have connections with the thalamus and the cerebellum, and it might well be that the basal ganglia somehow trigger the CCTC into oscillation.

Essential tremor (ET) to some extent is the opposite of PD classic tremor. It is a tremor of action, both postural and kinetic, but not of rest. Posture is an overlap with PD classic tremor. There is evidence that in ET the CCTC tremor is initiated with an error in timing of the motor command perhaps arising in dysfunction of the cerebellum itself or with an abnormal interaction with the Guillain-Molleret triangle, another oscillatory loop involving also the inferior olivary nucleus.

High-function 3T MRI gradient coil

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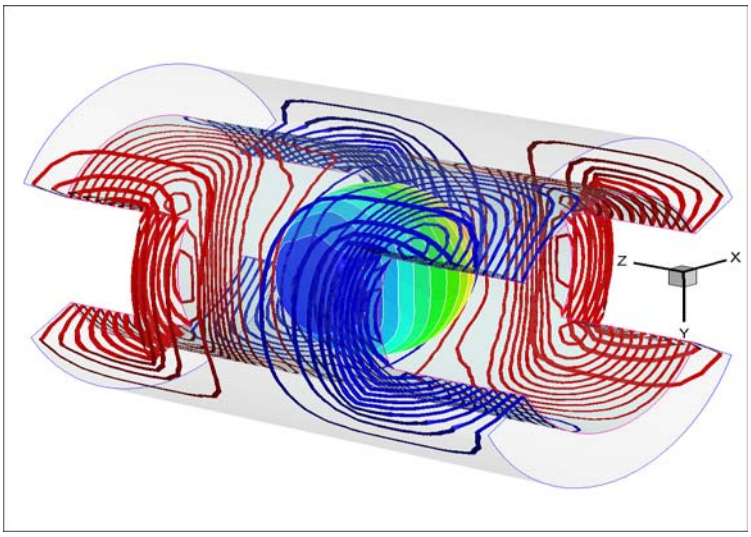
The MRI system is now routinely used in clinical situations not only brain disease but also various body organs. Then, the important issue is to use easily and stably, in addition to high resolution with various sequences. But our interest is to get the precise image of brain. In order to improve this situation, we make effort to achieve the high performance gradient coil for 3T MRI.

On the basis of the previous experience to build up the high temperature 3T MRI system using Bismus compound which enables super-conduction at 20 K and MRI microscope with 14T with 5 cm small bore, we plan to make high performance gradient coil (GC) for routinely used 3T MRI to improve the resolution. GC is one of the important key parts to get the image from NMR signals from the large space, segmenting the small voxels. We made the new concept GC with high performance for brain imaging. This GC is possible to use for 3T MRI commercially available from MRI venders to get the image of the brain. Compared to conventional GC, magnetic strength and slew rate of GC are double. This approach will be alternative to the high static field MRI such as 7T or 9.4T for routine clinical use with higher resolution images. We can avoid the high Tesla static magnetic field side effect and unstable functions using accustomed 3T MRI.

We adopted the symmetric GC instead of asymmetric coil in order to increase the current for GC. The GC system is now on the way of final production.



Research on Neuroscience and Biomedical Engineering with the growth of Instituted of Complex Medical Engineering

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In the twenty-first century, applications in medicine and engineering must acquire greater safety and flexibility if they are to yield better products at higher efficiency. To this end, neuroscience and biomedical technology must be integrated in medicine and engineering. We called the new research field as Complex Medical Engineering. In order to develop the new field, we have dedicated a new international society, Instituted of Complex Medical Engineering (ICME). Complex Medical Engineering (CME) consists of neuroscience, neurology, biomedical robotics and biomedical informatics, using medical and engineering methods to understand the complex system of human neural mechanisms, and to apply the basic findings to technology. CME means Neuroscience and Biomedical Engineering.

The First International Conference on Complex Medical Engineering (CME2005) was successfully held in Japan 2005, and the ICME was also founded during the conference. Until now, we have held 14 International Conference on Complex Medical Engineering. In the past 15 years, with the growth of ICME, our research on Neuroscience and Biomedical Engineering has also gained rich research achievements, such as from 2005 to 2007 we acquired a Grant-in-Aid for Scientific Research (B) about elucidation of multisensory modality memory mechanism and application to early diagnosis system for dementia; from 2009 to 2012 we acquired a Grant-in-Aid for Scientific Research (B) about State-of-the-art research on early diagnosis of dementia and social measures and overseas research on the latest international situation; from 2013 to 2017 we acquired a Grant-in-Aid for Scientific Research (A) about elucidation of brain function network of cognitive memory and creation of early clinical diagnosis system for dementia; from 2008 to 2021 we acquired a Grant-in-Aid for challenging Exploratory Research about the identification of a Brain Model with Touch Sensation and Its Application to a Robot Hand that Can Perceive Shape and Texture. We are very grateful to all members of ICME for

their support over the past 15 years. We hope in the future, we can bridge the gap between medicine & engineering and science & technology and help develop better methods of improving patients' lives.