Neuroradiology

NR-I *MRI in acute ischemic stroke management : Paradigm shift*
(4 speakers, 90 min)

NR-II ***Application of AI in magnetic resonance imaging***
(4 speakers, 90 min)

Cheng-Yu Chen, MD
陳震宇 教授

Time Table

Sunday, May 22, 2022
Room 203

Time	Topics	Speakers	Moderators
08:30-08:51 (21mins)	Deep Learning for MR Stroke Characterization	Peter Chang	Roh Eul Yoo Wan-Yuo Guo
08:51-09:12 (21mins)	Deep Learning reconstruction for neuroimaging	Koichiro Yasaka	Roh Eul Yoo Wan-Yuo Guo
09:12-09:33 (21mins)	Perfusion MRI analysis for radiogenomics of gliomas: Deep-learning approach	Kyu Sung Choi	Roh Eul Yoo Wan-Yuo Guo
09:33-09:54 (21mins)	Brain age as a potential biomarker for brain disorders	Wen-Yih Isaac Tseng	Roh Eul Yoo Wan-Yuo Guo
09:54-10:00 (6mins)	Q&A		Roh Eul Yoo Wan-Yuo Guo

Application of AI in magnetic resonance imaging

Organizer:Cheng-Yu Chen, MD

Overview:

The application of AI in medical image is booming. More consensuses are now on "how to utilize AI as a tool in the rapid-growing daily routine works in the disease diagnosis, quality improvement and therapeutic prediction". This session acclaims the AI innovation in neuroradiology. The emerging AI technology and machinery that bring together the complex clinical process will be presented by international and local experts on the topics of brain tumor, acute stroke, brain tumor and ageing.

This 90-minute symposium will appraise inspirational lectures by stellar casts from different AI-field experts, including professor Peter Chang from University of California at Irvine, professor Kyu Sung Choi from Seoul National University Hospital, professor Koichiro Yasaka from University of Tokyo, and professor Wen-Yih Isaac Tseng from National Taiwan University.

Deep Learning for MR Stroke Characterization

Peter Chang, MD USA

- Co-Director Center for Artificial Intelligence in Diagnostic Medicine University of California, Irvine
- Co-Director Precision Health through Artificial Intelligence (PHAI) University of California, Irvine
- Assistant Professor-in-Residence Department of Radiological Sciences University of California, Irvine
- Co-Founder and Chief Medical Officer Avicenna.ai La Ciotat, France

Deep Learning for MR Stroke Characterization

- **Synopsis:**
- Deep learning artificial intelligence technology is a rapidly expanding field with many applications in acute stroke imaging, including ischemic and hemorrhage subtypes. Early identification of acute stroke is critical for initiating prompt intervention to reduce morbidity and mortality. Artificial intelligence can help with various aspects of the stroke treatment paradigm, including infarct or hemorrhage detection, segmentation, classification and prognostication. In this talk, we will discuss the use of deep learning methods for accurate and efficient characterization of key stroke imaging endpoints including core infarct segmentation, penumbra prediction, advanced MR perfusion postprocessing, and prediction of imaging and clinical outcomes after ischemic stroke.

- **Key Reference:**

- Soun JE, Chow DS, Nagamine M, Takhtawala RS, Filippi CG, Yu W, Chang PD. Artificial Intelligence and Acute Stroke Imaging. AJNR Am J Neuroradiol. 2020 Nov.
- Nagamine M, Kohanteb P, Yu W, Chang PD, Chow DS. Accuracy of Artificial Intelligence in Measuring Intracerebral Hemorrhage Volumes and Expansion Compared to Human Estimates (5018). Neurology Apr 2020, 94 (15 Supplement) 5018.

Brain age as a potential biomarker for brain disorders

- Cofounder, Chief Scientist and Chief Medical Officer, AcroViz Inc, Taipei, Taiwan
- Adjunct professor, Institute of Medical Device and Imaging, National Taiwan University
- Adjunct radiologist, Department of Medical Imaging, National Taiwan University Hospital

Wen-Yih Isaac Tseng, M.D., Ph.D. Taiwan

Brain age as a potential biomarker for brain disorders

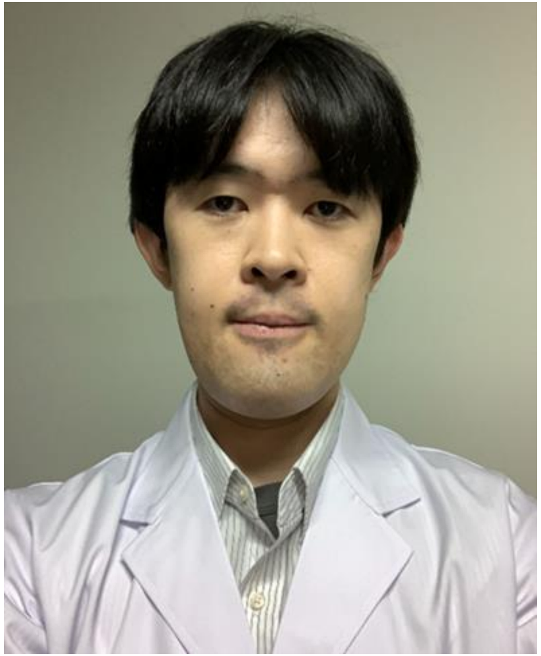
- ## Synopsis:

- Brain age prediction is derived from a machine learning algorithm that trains a large amount of brain MRI data from healthy participants to build a model to predict each individual's age. For healthy individuals, the predicted age matches his/her chronological age, with an acceptable amount of variations. For patients with Alzheimer's disease (AD), however, they exhibit a brain age that is beyond acceptable variations, implying that patient's brain undergoes accelerated aging. Multiple studies have shown that brain disorders such as schizophrenia, traumatic brain injury, major depression, and epilepsy also show apparently older brain age. The reason why brain age is elevated in brain disorders may arise from the fact that brain age is derived from brain structures that changes with age, and so it reflects the healthy status of the brain. Therefore, an older brain age may be more vulnerable to impairment of brain functions. This is evidenced by the studies showing that in patients who are diagnosed as mild cognitive impairment, those with older brain age have higher rate of conversion to AD. Other studies also found that brain age was associated with the severity of cognitive impairment and clinical symptoms. In sum, brain age may be a potentially useful biomarker for brain disorders and warrants further clinical validation.

- ## Key Reference:

- Tung, Y.H., Y.H., Chen, C.L., Lin, H.Y., Shang, C.Y., Yang, L.Y., Hsu, Y.C., Tseng, W.Y.I.*, Gau, S.S.F.*. Whole-brain white matter tracts deviation and idiosyncrasy from normative development in autism, ADHD and their unaffected siblings link with dimensions of psychopathology and cognition. American Journal of Psychiatry. 2021 Aug 1;178(8):730-743
- Tseng, W.Y.I.*, Hsu, Y.C.*, PhD; Kao, T.W. Brain age difference at baseline predicts CDR change in approximately two years. J Alzheimers Dis. 2022 Jan

Deep Learning reconstruction for neuroimaging



- Assistant Professor, Department of Radiology, The University of Tokyo Hospital, Japan

Koichiro Yasaka, MD, PhD, Japan

Deep Learning reconstruction for neuroimaging

- ## Synopsis:

- The quality of MRI image is affected by several imaging parameters. Most of them have pros and cons. For example, use of MRI units with higher static magnetic field results in higher signal-to-noise ratio (SNR); however, such MRI units are less accessible compared to those with lower static magnetic field. Increasing the numbers of excitation/acquisition would also improve the SNR; however, it is associated with prolonged imaging time.
- Deep learning is one of the strategies to realize artificial intelligence. Applications of deep learning to medical imaging has been gaining wide attention. Deep learning is applicable not only to imaging diagnosis but also to image processing. Deep learning reconstruction (DLR), which is based on deep learning technique and allows to improve the quality of MRI images, is now commercially available. DLR can improve the quality of MRI images without major trade-offs. In this presentation, how this technique benefits the radiological imaging diagnosis will be presented and discussed.

- ## Key Reference:

- Impact of deep learning reconstruction on intracranial 1.5 T magnetic resonance angiography. Jpn J Radiol 2021 [Epub ahead of print]
- Parkinson' s disease: Deep learning with a parameter-weighted structural connectome matrix for diagnosis and neural circuit disorder investigation. Neuroradiology 2021;63:1451
- Deep learning and artificial intelligence in radiology: Current applications and future directions. PLoS Medicine 2018;15:e100270

Perfusion MRI analysis for radiogenomics of gliomas: Deep-learning approach

Kyu Sung Choi, MD, Korea

- Clinical Professor, Department of Radiology, Seoul National University Hospital

Perfusion MRI analysis for radiogenomics of gliomas: Deep-learning approach

- **Synopsis:**
- Perfusion-weighted MRI has been known to capture the perfusion characteristics of gliomas, leading to not only the histopathologic grading of gliomas, but also the prediction of genetic characteristics. Parametric maps are generated from the raw perfusion-weighted MRI data using a pharmacokinetic model. However, parametric maps lose dynamic information due to temporal averaging. This talk will discuss about how we tackled these limitations using deep-learning approaches. Parametric maps from dynamic susceptibility contrast (DSC) MRI such as relative cerebral blood volume (rCBV) maps, can estimate blood volume in the tumor, losing dynamic information of time-intensity curve at the same time. Moreover, representative values such as mean rCBV values can evaluate the group difference, discouraging individual classification at the same time. I will introduce the recurrent neural network model to capture the temporal feature representing perfusion characteristics of gliomas, leading to individual prediction of IDH genotype of gliomas as a clinical application.
- On the other hand, we briefly analyze of the results of RSNA-MICCAI BraTS 2021, the latest radiogenomic challenge, which aimed to predict the methylation status of the O6-methylguanine DNA methyltransferase (MGMT) promotor in glioma with conventional structural sequences. Perfusion MRI may provide more accurate prediction of genetic characteristics than conventional structural sequences.

- **Key Reference:**

- Shim KY, Chung SW, Jeong JH, Hwang I, Park C-K, Choi KS*, et al. Radiomics-based neural network predicts recurrence patterns in glioblastoma using dynamic susceptibility contrast-enhanced MRI. Scientific Reports. 2021; 11(1):9974
- Choi, K. S., Kim, S., Kim, B. H., Jeon, H. J., Kim, J. H., Jang, J. H., & Jeong, B.. Deep graph neural network-based prediction of acute suicidal ideation in young adults. Scientific reports. 2021; 11(1), 1-11.
- Kim, A. R., Choi, K. S., Kim, M. S., Kim, K. M., Kang, H., Kim, S., ... & Park, C. K.. Absolute quantification of tumor-infiltrating immune cells in high-grade glioma identifies prognostic and radiomics values. Cancer Immunology, Immunotherapy. 2021; 70(7), 1995-2008.