Longitudinal influence assessment of paediatric stroke events on resting state networks

R. Licandro1,2, K.H. Nenning2, K. Kollndorfer2, L. Bartha-Doering2, G. Langs2

1 Vienna University of Technology, Institute of Computer Aided Automation, Computer Vision Lab, Vienna, Austria 2 Medical University of Vienna, Department of Biomedical Imaging and Image-guided Therapy, Computational Imaging Research Lab, Vienna, Austria

Background: In this work resting state functional Magnetic Resonance Imaging (rsfMRI) is used to assess functional organization of resting state networks in children after ischemic stroke. The challenge of this longitudinal study among children is to identify functional connectivity induced by the age and developmental related changes of the brain (natural plasticity), but also by pathology related modifications, and functional and structural reorganisation (adaptive plasticity) of brain tissue. For a successful treatment, it is important to understand the developmental and compensatory functional processes of children suffering from stroke. We propose a longitudinal influence measurement on the development and modification of resting state connectivity networks in the paediatric brain after stroke between 7 and 17 years.

Methods: We track changes in the functional connectivity structure on a rsfMRI dataset containing 18 control and 16 ischemic stroke cases in the age range of 7 to 17 years. We quantify the intrinsic functional connectivity in the default mode network, and evaluate the influence of age, age at stroke and regeneration time (time between data acquisition and occurrence of stroke, which lies between 0 and 15 years). As a reference, we perform the same analysis on the vision network.

Results: The results show that the average intrinsic functional connectivity in control cases is higher in comparison to stroke cases independent of the network observed. Stroke cases show a higher asymmetric functional connectivity as well as impaired connectivity structure. The age at stroke shows more influence on resting-state networks than the regeneration time. It is observable that the difference between the average intrinsic functional connectivity of stroke and control group minimizes according to the increasing age at stroke and also minimizes in the left hemisphere to increasing regeneration time.

Conclusions: In this work we longitudinally assessed the influence of stroke events on functional connectivity in the paediatric brain and measured an influence of the age at stroke on the developing default networks. For future work normalized psychological tests will be integrated and used to estimate dependencies between speech development and IQ. Also graph-based network measures are considered to be used for future analysis, e.g. clustering coefficient, small worldness measures to identify the development of network clusters or motif measures for identifying patterns of local connectivity.