BrainComp2022 - Computational Challenges of Connectivity

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MEDUSA: an HPC-based simulation environment to create decoders of white matter microstructure

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The Ginkgo team of NeuroSpin's BAOBAB/GAIA laboratory is developing within the framework of the Human Brain Project an environment called MEDUSA (Microstructure Environment Designer Using Sphere Atoms) that allows the creation of realistic virtual tissues representative of cellular environments encountered in the human brain, to simulate the scattering process and thus predict the MRI signal that you would get for each virtual tissue. The major contribution of artificial intelligence techniques opens up new perspectives for the development of in vivo imaging methods of the cytoarchitecture of the cortex since it becomes possible to exploit the microscopic information embedded in the water diffusion process present in the brain and whose trajectories embody an imprint of the local cytoarchitecture of the tissue. Initial results have shown that this environment allows the development of models of the local cytoarchitecture, such as computational models which are far more robust than the analytical models commonly used to decode the local cytoarchitecture of brain tissue. This approach based on the use of artificial intelligence techniques provides an appropriate framework for the decoding of the cellular disorders induced in the white matter in case of stroke.

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Session Classification: Connectivity: The network perspective