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Streszczenie w j. angielskim do rozprawy doktorskiej pt. „A Hybrid Method for Tractography in Neurosurgery Using Artificial Neural Networks and Path Search Algorithms"

Neurosurgery is one of the youngest and most demanding fields of medicine. It concerns surgical interventions within the central nervous system - the system that coordinates and influences the activity of all parts of the human body. Most neurosurgeries focus on the brain itself. It is a delicate organ of microscopic cellular structures that require extreme precision during the intervention. Despite the risk of impairments, such surgeries are necessary for treating many pathologies, like glioblastoma.

The development of imaging techniques in recent decades, especially MRI, helped profoundly to map important structures non-invasively. Specific modalities, like fMRI or DTI, allow visualization of the near-precise location of functional regions and neural pathways, respectively. These experiments result in a large amount of data that has to be thoroughly analyzed. This task puts much work on radiologists, especially when not equipped with additional tools, like image recognition algorithms. In recent years, artificial intelligence has assisted radiologists and neurosurgeons in their work through decision support systems. They are developed to analyze experimental results landing advice for trained physicians. They can help better plan and perform neurosurgeries by integrating with live neuronavigation systems.

This thesis introduces a novel method for analyzing diffusion data obtained from MRI experiments. A presented hybrid technique comprises a neural network for diffusion data analysis and a path search algorithm computing the topology of nerve fibers based on the analyzed data. This information is suitable for multiple applications, including estimating the topology of the neural pathways near the surgical field or producing maps of connections between different brain functional areas. Neurosurgeons and radiologists can use such knowledge for pre-operative planning and intra-operative navigation.

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