Cyprus University of Technology

Engineering & technology

Bachelor's Thesis

Integrated Tool for Three-dimensional Reconstruction of Multiple Sclerosis Magnetic Resonance Images

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Limassol, May 2021

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I would like to give special thanks to my supervisor Dr. Christos Loizou for the inspiration and guidance that he gave me throughout my thesis. His knowledge and expertise were invaluable on formatting the research questions and methodology. I would like to acknowledge Dr. Constantinos Pattichis for the extra support and feedback on the development of the integrated system developed in this work. His advice was of great value with regards to the system's implementation. I would like also to thank Dr. Marios Pantziaris whose expertise and experience in multiple sclerosis were a milestone for the image dataset selection. In addition, I would like to thank my colleague Andreas Georgiou for contributing to the integrated system. His work on the semi-automated segmentation system was a key factor for the development of the system. Last but not least, I would like to show appreciation to my friends and family for the sympathetic discussions and advice. Finishing the project without their company would be impossible.

ABSTRACT

Introduction: Multiple Sclerosis (MS) is an autoimmune demyelinating disease of the central nervous system. Magnetic resonance (MR) scanners are used as tools to image the human brain in order to spot and diagnose the MS lesions. A three-dimensional reconstruction (3D) software is developed to visualize MS MRI acquisitions in a 3D scene, which will assist the doctor for following up the evolution of the MS disease.

Methods: The International Symposium of Biomedical Imaging (ISBI) in 2015 provided a dataset of MRI scans from 19 subjects with MS. Five subjects were used at four consecutive time points (TP) each, with acquisition time interval of an average 12 months. The ISBI dataset provided also the manually segmented lesions performed by two experts (R_1, R_2). The dataset was used to reconstruct the images, estimate, and compare the lesion load and lesion volume. The system consists of five stages, namely image preprocessing in form of additive noise filtering and image intensity normalization, semi-automated lesions segmentation based on a system developed in another work, 3D reconstruction based on the translucent direct volume rendering method, visualization based on the ray casting method, lesion load and volume estimation of the lesions and method evaluation. Segmented lesions were manually provided by two experts and semi-automated segmentation system.

Results: For all above images the lesions load and volume were estimated and compared at the four different TP as well as between manual and automated segmentations. Preliminary promising results show that the 3D reconstruction system could be used in future clinical or research work. Therefore, further investigation and validation in a larger number of subjects with additional evaluation metrics, as well as further expansion of the system to include automated registration method and 3D texture analysis should be performed in the future.

Keywords: Multiple Sclerosis, Three-dimensional Reconstruction, Magnetic Resonance Imaging, Integrated System.