Deep learning techniques for contouring MRI

By quantitatively studying the microenvironment of tumours, we can determine the optimal treatment for individual patients and greatly improve healthcare. Retrieving such quantitative parameters from MR-images necessitates contouring regions of interest from which we assess the quantitative value. Currently, an expert clinician places these ROIs manually. Such a process is labour-intensive and prone to errors.

Automation of contouring could substantially decrease the workload while increasing contour consistency. In recent years, computer vision has greatly improved, especially due to the introduction of convolutional neural networks. One network that enables biomedical image contouring is the U-net [1,2].

In this project, the student will use the latest deep learning technologies to teach neural networks to accurately contour quantitative MR images so quantitative information can be extracted. In the future, the quantitative information will be used to guide diagnosis and treatment.

Requirements

We are looking for Bachelor and Master students with a technical background (e.g. Technical Medicine, Medical sciences, Computational sciences, Physics, Mathematics) with an interest in medical imaging and machine learning. Experience with programming (particularly Python, but Matlab/Mathematica/C++ experience is also welcome) is strongly desired.

Learning goals

Primarily, the student will learn about deep learning and gain hands on experience. In particular, the student will learn programming in Python and the related machine learning packages (e.g. Tensor flow and Keras). Secondarily, the student will learn working with medical imaging data and, in particular, learn how MRI images are generated. Depending on the length of the project and the results, we will aim at getting the work published by the end of the project, particularly for 1-year projects.

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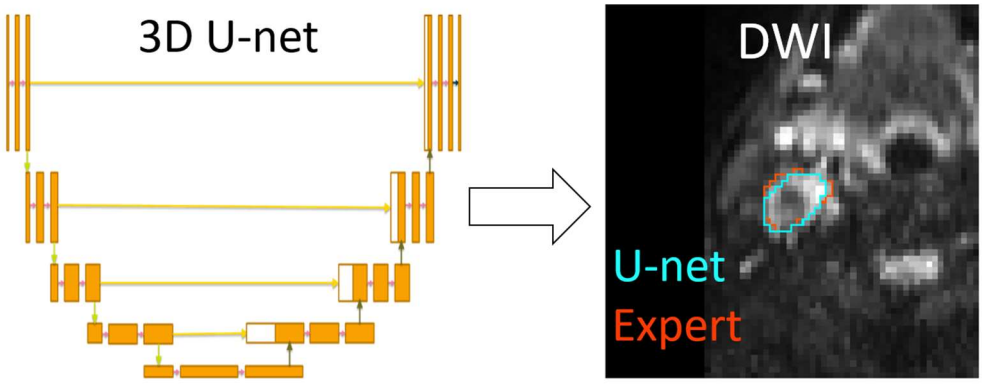

References

[1] Ronneberger O, Fischer P, Brox T. U-net: Convolutional networks for biomedical image segmentation. Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), 2015. https://doi.org/10.1007/978-3-319-24574-4_28.

[2] Çiçek Ö, Abdulkadir A, Lienkamp SS, Brox T, Ronneberger O. 3D U-net: Learning dense volumetric segmentation from sparse annotation. Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), 2016. https://doi.org/10.1007/978-3-319-46723-8_49.

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