

A Directional Gradient For Morphometry of Sciatic Nerve Images

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Abstract:

The extraction of morphometric features from images of biological structures is a crucial task for the study of several diseases. Particularly, concerning neuropathies, assessing the state of the myelination process is vital and may be an indicator of the disease type and state. Few approaches exist to automatically analyse nerve morphometry and assist researchers in this time consuming task. Along with being time consuming, this task is likely, if done manually, to be a subject of many sources of error such as: fatigue of the analyser, expertise performing the analysis and the usage of small regions instead of the image of the whole nerve section. The structure of the nervous fibre as well as the method used to obtain the image greatly hinders the task of finding an approach suitable for all conditions.

The aim of this work was to develop an algorithm to detect axons and myelin contours in myelinated fibres specifically developed for sciatic nerve images, thus allowing the automated assessment and quantification of myelination through the measurement of the g-ratio. The application of a directional gradient together with an active contour algorithm was able to effectively and accurately determine the degree of myelination in an imagiological dataset of sciatic nerves. The achieved results were compared with the ones obtained with an existing method of conventional gradient, which confirmed the algorithm's robustness. The validation process proved that the automatic process results were very close to the ones obtained by a manual process, with an average absolute error of 1.80% (differences were never greater than 3.37%).

These results suggest that the proposed approach is useful, reproducible and robust enough to reliably extract morphometric features from the images under analysis and, hence, replace the manual process. With this automatic technique it is possible to mislead those sources of error by patronizing the analysis and also to greatly reduce the execution time.