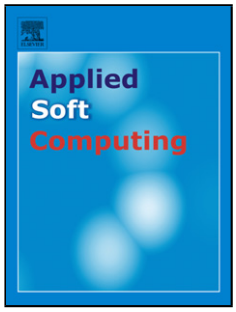

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Identifying central and peripheral nerve fibres with an artificial intelligence approach

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Abstract

Distinguishing axons from central or peripheral nervous systems (CNS or PNS, respectively) is often a complicated task. The main objective of this work was to facilitate and support the process of automatically distinguishing the different types of nerve fibres by analysing their morphological characteristics. Our approach was based on a multi-level hierarchical classifier architecture that can handle the complexity of directly identifying nerve-fibre groups belonging to either the CNS or the PNS. The approach adopted comprises supervised methods (multilayer perceptron and decision trees), which are responsible for distinguishing the origin of the axons (CNS or PNS), whereas the unsupervised method (K-Means clustering) performs nerve fibre clustering based on similar characteristics for both the CNS and PNS. Our experiments produced results with an accuracy higher than 88%. Our findings suggest that the development and implementation of a multi-level system improves automation capabilities and increases accuracy in the classification of nerves. Furthermore, our architecture allows for generalisation and flexibility, which can subsequently be extended to other biological control systems.

Keywords: artificial neural network, k-means clustering, decision trees, decision support system, nerve fibres, multi-level classifier

1. Introduction

The number of published works related to nerve fibres has progressively increased from the beginning of the 20th century as shown in Figure 1. A rapid search in PubMed revealed the publication of approximately 130,000 pertinent papers during this period. Almost 40% of these, approximately 50,600 articles, were published in the first 14 years of the 21st century, with most (78%) in the last ten years.

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