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Flexible Rule Extraction Algorithm for Surgery Candidate Selection for Temporal Lobe Epilepsy using Swarm Intelligence

Mostafa Ghannad Rezaie[1], H. Soltanian-Zadeh[1], and K. Elisevich[2]
Departments of Radiology[1] and Neurology[2], Henry Ford Health System, Detroit, MI

Background: Diagnosis of complex neurological disorders requires multimodality analysis. New advances in medicine provide a broad range of noninvasive evaluation methods. However, huge amounts of raw data may confuse clinicians and decrease their diagnosis accuracy. To remedy this problem, computerized knowledge extraction has become an active area of research in medical informatics. This paper proposes a new data mining method based on advanced swarm intelligence (SI). Considering medical knowledge discovery difficulties, this approach addresses common issues such as missing values and interactive rule extraction. In our research, surgery candidate selection for temporal lobe epilepsy is the main target application. However, the proposed method can be applied to other applications.

Experimental Approaches: We have developed a rule extraction approach for the Human Brain Image Database System (HBIDS) being developed for epilepsy at the Radiology Image Analysis Laboratory. Multimodality datasets including MRI, SPECT, patient's clinical history, and results of EEG analysis are combined to make a suggestion. The algorithm enables clinicians to modify the results extracted from the datasets by inserting new rules or deleting some of the suggested rules. The results are evaluated using powerful cross-validation algorithms to optimize their generalization capability.

Results: The algorithm is applied to multimodality data from 35 HBIDS patients. Although most of the patients had hippocampus analysis based on MRI and SPECT, there were missing values that were managed by the proposed algorithm. The final algorithm showed 84.2% accuracy, 81.9% sensitivity, and 91.8% specificity. Comparing to common data mining approaches such as C4.5 and ID3, the new method showed considerable improvement.

Conclusions: Experimental results show noticeable performance improvement in the final rule-set quality by the proposed method. The method is flexible and fast and its performance can be further improved by integrating it with support vector machines (SVM).

Person to whom correspondence to be directed:
Name: Mostafa Ghannad Rezaie
E-Mail: mostafa@rad.hfh.edu
Department/Division: Radiology Research Image Analysis
Phone Number: 874-4354
Fax Number: 874-4494

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