Chapter 2
A Medical Decision Support System Based on Ensemble of Complex-Valued Radial Basis Function Networks

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ABSTRACT

The use of machine learning techniques for medical diagnosis has become increasingly common in recent years because, most importantly, the computer-aided diagnostic systems developed for supporting the experts have provided effective results. The authors aim in this chapter to improve the performance of classification in computer-aided medical diagnosis. Within the scope of the study, experiments have been performed on three different datasets, which include heart disease, hepatitis, and BUPA liver disorders datasets. First, all features obtained from these datasets were converted into complex-valued number format using phase encoding method. After complex-valued feature set was obtained, these features were then classified by an ensemble of complex-valued radial basis function (ECVRBF) method. In order to test the performance and the effectiveness of the medical diagnostic system, ROC analysis, classification accuracy, specificity, sensitivity, kappa statistic value, and f-measure were used. Experimental results show that the developed system gives better results compared to other methods described in the literature. The proposed method can then serve as a useful decision support system for medical diagnosis.

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INTRODUCTION

In medical diagnostics, diagnosis of a disease is performed with considering patient’s data. However, the increase in the data density and the excessive number of symptoms affecting the disease complicate diagnostic procedures. Amongst one of the most popular topics to emerge in recent years is the use of computers in medical diagnostic. Computer-aided medical diagnostic systems have been developed to help specialists, with such systems aiming to minimising the physician error. Computer-aided classification systems can minimise the potential errors. In addition, these systems facilitate and accelerate in-depth examination of medical data (Cheung, 2001; Das, 2010).

In order to test the effectiveness of newly developed computer-aided medical diagnostic systems, researchers are conducting experiments on datasets that are open to common use. The hybrid method proposed in this study has been tested with three datasets. Those are Statlog heart disease, BUPA liver disorders, and Hepatitis datasets, which are obtained from the UCI machine learning repository (Bache & Lichman, 2013). The common characteristic of these datasets is having a distribution which cannot be separated linearly. There is also a large amount of missing data on the Hepatitis dataset. Information about some of the earlier studies carried out on these datasets is given below.

In the literature, some studies performed on the Statlog heart disease dataset are as follows: Based on many attempts, Cheung (2001) has achieved the highest classification accuracy (81.48%) using the Naive Bayes algorithm among a number of other classification algorithms. Kahramanli and Allahverdi (2008) have achieved 86.8% accuracy rate by using a fuzzy neural network algorithm. Das et al. (2009) have developed an ensemble algorithm which includes three neural networks and an 89.01% classification accuracy has been obtained with the proposed model. Subbulakshmi et al. (2012) have achieved an 87.50% classification accuracy by using the extreme learning machine (ELM) method. Karabulut and Ibrikci (2012) have developed a method based on a rotation forest algorithm, and a 91.20% classification accuracy has been obtained with the proposed method.

In the literature, some studies that have been carried out on the Hepatitis dataset are as follows: Javad et al. (2012) have developed a hybrid method (SVM-SA) which includes SVM and simulated annealing (SA) algorithms. They have obtained a 96.25% accuracy rate. Shao et al. (2015) have proposed a weighted linear loss twin SVM for large-scale classification. They have obtained an 84.99% accuracy rate with the method. Aldape-Pérez et al. (2012) have developed a novel method referred to as an associative memory based classifier (AMBC) and an 85.16% classification accuracy has been obtained. Bashir et al. (2016) have developed an ensemble method...
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