Determination of the Bioimpedance Analysis Parameters in Dengue Patients Using the Self Organizing Map

T. Faisal, F. Ibrahim and M.N. Taib

INTRODUCTION

Dengue virus is endemic in many parts of tropical and subtropical world [1,2]. It was reported in the Americas, southern Europe, North Africa, the eastern Mediterranean, Asia, Australia, various islands in the Indian Ocean, the south and the central pacific and the Caribbean [3]. The worldwide threat of Dengue virus has increased dramatically. Approximately, 2.5 billion people facing risk in these areas and it's predicted that this number will increase as transmission spreads to neighboring geographic regions [4, 5]. Accordingly, dengue disease is considered as the major public health affair.

Accurate diagnosis in time and monitoring of severity of any dengue infection is needed in order to identify the degree of the disease severity and to provide the appropriate treatment. In order to treat and control the dengue disease, many strategies have been developed and promoted by world health organization (WHO) [3]. However, all of these studies were based on laboratory and blood test finding in order to monitor the progress in dengue patients. Even though, these methods can give accurate diagnoses, they are invasive and time consuming [4, 5]. The reason behind this assumption is the frequent blood taking will cause further injury to the subcutaneous tissue and potentially hazardous to the DHF patient [4]. Few studies were conducted to achieve accurate diagnosis without facing the abovementioned drawbacks. One of these study is implementing the bioelectrical impedance analysis (BIA) technique for monitoring and classifying the daily risk to patients suffering from DHF which is proposed by Ibrahim et al [4]. Significant outcome was attained by using this technique where

the results proved the capability of the BIA to classify the daily risk of DHF patients. The study was conducted based on statistical analysis for the variation of the reactance in the dengue patients [4].

In order to have wide view of the all BIA parameters this study was conducted. The study aimed to determine the significant BIA parameter which can distinguish between the dengue patients and the healthy subjects using nonstatistical technique. One of the most powerful aids for visualizing, understanding, and exploring the complexity of the high-dimensional data is self-organizing map (SOM) technique. It maps high-dimensional data into a simple lowdimensional display so that it can simplify the complexity of the data. SOM has been used for several engineering and biomedical applications such as speech recognition, robotics, telecommunication, medical diagnosis, prosthesis control and gene expression [6, 7, 8, 9, 10, 11, 12, 13].

Therefore, this paper presents SOM as a tool for visualizing, understanding, and exploring the significant parameter among of 17 BIA parameters in the dengue patients and the healthy subjects.

BIOELECTRICAL IMPEDANCE ANALYSIS

BIA is the technique which evaluates the human body composition such as bioelectrical tissue conductivity BETC (i.e impedance, reactance, phase angle, body capacitance), mass distribution (i.e Body cell mass and Extracellular Mass), and water compartments (i.e Intracellular Water, Extracellular Water) by passing small current through it. The majority of the impedance measurements are using four electrode systems to pass the small current through the human body. Small current with 50Hz will pass between two of the electrodes while the voltage drop across this same area is then measured using the other pair of electrodes. The voltage drop will determine the impedance of the whole body. This data can be converted to estimate the extracellular water, intracellular water, fat free mass, and fat

mass through recognized regression equations [21].

SELF ORGANIZING MAP

The self-organizing map algorithm is the unsupervised learning technique. It consists of two layers of unsupervised neural network. This type of neural networks doesn't require any targets or outputs for learning. It receives a number of different multivariable input samples, discovers significant relation in these samples and presents them into two dimensional map or display. The process for construction the self-organizing map is performing in three stages: competition, cooperation, and adaptation [14, 15, 16, 17, 18]. In the competition stage all the samples will be presented to the network and all the neurons in the network will be competent to determine the winning neuron. The cooperation among neighbouring neurons is determined by finding the spatial location of a topological neighbourhood. The adaptation stage is aimed to let the network attain the self organize configuration.