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A computational method to differentiate rheumatoid arthritis patients using thermography data

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ABSTRACT

BACKGROUND: The traditional Rheumatoid Arthritis (RA) diagnosis is very complicated because it uses many clinical and image data. Therefore, there is a need to develop a new method for diagnosing rheumatoidal arthritis using a consolidated set of blood analysis and thermography data.

OBJECTIVE: Herein are discussed the following issues related to RA disease: 1) Which clinical data are significant in the primary diagnosis of rheumatoid arthritis; 2) What parameters from thermograms should be addressed in differentiation patients with rheumatoid arthritis from the healthy; 3) Does artificial neural networks can differentiate patients with rheumatoid arthritis from the healthy?

METHODS: The dataset was composed of clinical and thermal data from 65 randomly selected patients with Rheumatoid Arthritis and 104 healthy subjects. Firstly, the univariate logistic regression model to find significant predictors was proposed. Next, the feedforward neural network model was used. The dataset was divided into the training set (75% of data) and the test set (25% of data). The Broyden-Fletcher-Goldfarb-Shanno (BFGS) and non-linear logistic function to transformation nodes in the output layer were used for training. Finally, the 10 fold Cross-Validation was used to assess the predictive performance of the artificial neural network (ANN) model and to judge how it performs.

RESULTS: The training set consisted of the temperature of all fingers, patient age, BMI, erythrocyte sedimentation rate, C-reactive protein and White Blood Cells (10 parameters in total). A high level of sensitivity and specificity was obtained at 81.25% and 100%, respectively. The accuracy was 92.86%.

CONCLUSIONS: This methodology suggests that the thermography data can be considered in addition to the currently available tools for screening, diagnosis, monitoring of disease progression.

KEYWORDS: rheumatoid arthritis, inflammation, neural networks, thermography.