World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:14, No:03, 2020

Prediction of Sepsis Illness from Patients Vital Signs Using Long Short-Term Memory Network and Dynamic Analysis

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Abstract : The systems that record patient care information, known as Electronic Medical Record (EMR) and those that monitor vital signs of patients, such as heart rate, body temperature, and blood pressure have been extremely valuable for the effectiveness of the patient's treatment. Several kinds of research have been using data from EMRs and vital signs of patients to predict illnesses. Among them, we highlight those that intend to predict, classify, or, at least identify patterns, of sepsis illness in patients under vital signs monitoring. Sepsis is an organic dysfunction caused by a dysregulated patient's response to an infection that affects millions of people worldwide. Early detection of sepsis is expected to provide a significant improvement in its treatment. Preceding works usually combined medical, statistical, mathematical and computational models to develop detection methods for early prediction, getting higher accuracies, and using the smallest number of variables. Among other techniques, we could find researches using survival analysis, specialist systems, machine learning and deep learning that reached great results. In our research, patients are modeled as points moving each hour in an n-dimensional space where n is the number of vital signs (variables). These points can reach a sepsis target point after some time. For now, the sepsis target point was calculated using the median of all patients' variables on the sepsis onset. From these points, we calculate for each hour the position vector, the first derivative (velocity vector) and the second derivative (acceleration vector) of the variables to evaluate their behavior. And we construct a prediction model based on a Long Short-Term Memory (LSTM) Network, including these derivatives as explanatory variables. The accuracy of the prediction 6 hours before the time of sepsis, considering only the vital signs reached 83.24% and by including the vectors position, speed, and acceleration, we obtained 94.96%. The data are being collected from Medical Information Mart for Intensive Care (MIMIC) Database, a public database that contains vital signs, laboratory test results, observations, notes, and so on, from more than 60.000 patients.

Keywords : dynamic analysis, long short-term memory, prediction, sepsis
Conference Title : ICBI 2020 : International Conference on Bioinformatics
Conference Location : Tokyo, Japan
Conference Dates : March 23-24, 2020