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SHORT-TERM TREND FORECAST OF NEUROPHYSIOLOGICAL SIGNALS FOR MEDICAL DECISION SUPPORT

Feng Zhang[1], Mengling Feng[1], Jialin Sinno Pan[1], Liang Yu Loy[1], Wenyuan Guo[1], Zhuo Zhang[1], Cuntai Guan[1], Nicolas Kon Kam King[2], Beng Ti Ang[2]
[1]Institute for Infocomm Research, Singapore, Singapore, [2]National Neuroscience Institute, Singapore, Singapore

PURPOSE: Timely treatment is crucial to mitigate the secondary injury caused by intracranial pressure (ICP) elevation to patients with traumatic brain injury. In the current approach, treatment is often applied only after sustained and significant ICP elevation is observed. It is difficult and troublesome for clinicians to conduct timely treatment for patients without information of the future trends in neurophysiological signals. Therefore, we propose an autoregressive moving average based mean forecast algorithm (ARMA-MFA) to predict the short-term future trends in the neurophysiological signals.

METHODS: In our proposed ARMA-MFA algorithm, in order to obtain the features for forecast, the data of a neurophysiological signal is divided into windows. Each past window is further segmented into several finer sub-windows with varying size. Nearer data has a higher resolution than remote ones, because future trends are more likely to be related to the more recent neurophysiological conditions. The ARMA-MFA algorithm predicts the future mean of each sub-window in a future window and then obtains the mean of that future window based on the weighted average of those of the sub-windows.

RESULTS: ARMA-MFA algorithm achieved satisfactory results in forecasting the future mean of ICP, mean arterial pressure, central venous pressure and heart rate. 94%, 89% and 82% of the forecasted ICP mean values are within one sigma interval of the actual values for 5 minutes, 15 minutes and 30 minutes forecast ranges, respectively. The shorter the prediction horizon is, the easier to catch the trends of signals, and therefore the more accurate the forecast is.

CONCLUSION: Our proposed short-term trend forecast method assists clinicians in choosing the optimal medical treatment option. By providing alerts for possible future life threatening conditions identified, it also helps clinicians get better prepared for critical interventions or surgeries, so as to optimize the resource allocation and outcome of patients.