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Real-Time Classification of Hemodynamic Response by Functional Near-Infrared Spectroscopy Using an Adaptive Estimation of General Linear Model Coefficients

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Abstract : Near-infrared spectroscopy allows monitoring of oxy- and deoxy-hemoglobin concentration changes associated with hemodynamic response function (HRF). HRF is usually affected by natural physiological hemodynamic (systemic interferences) which occur in all body tissues including brain tissue. This makes HRF extraction a very challenging task. In this study, we used Kalman filter based on a general linear model (GLM) of brain activity to define the proportion of systemic interference in the brain hemodynamic. The performance of the proposed algorithm is evaluated in terms of the peak to peak error (Ep), mean square error (MSE), and Pearson's correlation coefficient (R2) criteria between the estimated and the simulated hemodynamic responses. This technique also has the ability of real time estimation of single trial functional activations as it was applied to classify finger tapping versus resting state. The average real-time classification accuracy of 74% over 11 subjects demonstrates the feasibility of developing an effective functional near infrared spectroscopy for brain computer interface purposes (fNIRS-BCI).

Keywords : hemodynamic response function, functional near-infrared spectroscopy, adaptive filter, Kalman filter
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