Localization of transient signal high-values in laser Doppler flowmetry signals with an empirical mode decomposition

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Résumé en anglais	The laser Doppler flowmetry (LDF) technique provides the monitoring of microvascular blood flow perfusion. However, LDF monitors based on fiber-optic transducers have the serious drawback of generating TRAnsient Signal High-values (TRASH) in signals. These TRASH correspond to artifacts for clinicians as they prevent interpretations of the signal when they are numerous. Moreover, TRASH exclude the possibility of direct signal processing and analyses. Therefore, in clinical routines, a human visual inspection of LDF signals is necessary to detect TRASH and to process the signals accordingly. This may be very time consuming. An algorithm able to localize TRASH automatically for their removal is therefore of interest. However, the development of such an algorithm is not an easy task as TRASH amplitude can be lower, higher, or in the same amplitude range as responses to stimuli such as post-occlusive hyperemia. The recently introduced empirical mode decomposition (EMD) has the advantage of splitting any kind of signal into fast and slow oscillations. Relying on these properties, the authors evaluate the possibility for EMD to localize TRASH automatically. For this purpose, LDF signals from 28 men of different ages are recorded at rest, during a vascular occlusion of 3 min , followed by a post-occlusive hyperemia. For each signal containing TRASH, the first intrinsic mode function obtained with the EMD is processed with a running window-based analysis in which a thresholding of the local maxima is carried out for the localization of TRASH. From the data, the use of a window width of 25 s is suggested. The results show effective and potential usefulness of this algorithm for an automatic localization of TRASH. Moreover, the method proposed has the advantage of being insensitive to the rapid increases of blood flow induced by post-occlusive hyperemia, which is of interest for clinicians. Because it is both local and fully data adaptive, EMD appears as an appealing processing technique for overcoming some of the limitations of the LDF.
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