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INDICATOR OF THE QUALITY OF THE SENSOR SET UP: A STUDY USING SURFACE EMG ON SUB-BAND ICA

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Abstract. *Surface electromyogram (sEMG) is a non-invasive recording and it has numerous applications. Multiple electrical sensors are essential for extracting intrinsic physiological and contextual information from the corresponding sEMG signals. The reason, why more than just one sEMG signal capture has to be used, is as follows: Due to signal propagation inside the human body in terms of an electrical conductor, there cannot be a one-to-one mapping of activities between muscle fibre groups and corresponding sEMG sensing electrodes. Each of such electrodes rather records a composition of many, and widely activity-independent signals, and such kind of raw signal capture cannot be efficiently used for pattern matching due to its linear dependency. On the other hand, Independent Component Analysis (ICA) provides the perfect answer of un-mixing a set of skin surface recordings into a vector (set) of independent muscle actions. Hence, there is a need for a method that indicates the quality of the sensor set in sEMG recording. The purpose of this paper is to describe the use of source separation for sEMG based on ICA. We demonstrate how this can be used in practical sEMG experiments, when the number of recording channels for electrical muscle activities is varied.*

Keywords: Hand gesture sensing, Bio-signal analysis, Independent component analysis (ICA), Surface electromyography (sEMG), Blind source separation (BSS)

1. **Introduction.** In controlling wearable computer devices, surface electromyogram can be used to detect hand movement information. Surface EMG as non-invasive sensing represents an important indicator of muscle activity [1, 2]. From sEMG raw signal captures, recognition of multiple gestures is possible with a post processing as long as activity of more than just one muscle group is traced by recording electrical signals at different skin positions. Of course, the number of electrodes and their placement play a significant role in such experiments. Pre-processing of the recorded raw signals is required, because cross-talk among adjacent recording channels makes it impossible to separate individual independent sources. An activity scheme of independent sources is mandatory for efficient pattern mapping. In this regard, proper unmixing of electromyogram (EMG) raw signals appears essential for data classification and recognition. Blind source separation (BSS) techniques are commonly used for detecting independent muscle activities in bio-signal investigations and experiments [3, 4, 5, 6, 7, 8, 9].

BSS generally is a signal processing method, which recovers the contributions of different sources from a finite set of observations that are recorded by, e.g., electrical/electronic sensors. This method has to work independent of the propagation medium and without any prior knowledge of the sources. BSS has already been successfully applied in medicine, telecommunications and image processing [6, 7, 9, 10, 11, 12, 13, 14, 15, 16]. Independent component analysis (ICA) [17, 18, 19, 20] represents meanwhile a widely