Are Dual-channel Methods as Accurate as Multi-channel Methods to Suppress the Cardiopulmonary Resuscitation Artifact?

Unai Ayala*, Joar Eilevstjnn, Unai Irusta, Trygve Eftestl, Erik Alonso and Digna González

Department of Electronics and Telecommunications
University of Basque Country

In the last decade, several adaptive filters have been proposed to suppress the cardiopulmonary resuscitation (CPR) artefact for a reliable diagnosis by automated external defibrillators (AED). Initially, a multi-channel MC-RAMP filter based on four reference channels was proposed. Later, dual-channel LMS and Kalman filters based on the chest compression frequency were proposed to ease the implementation. However, these studies used different ECG data and AED algorithms. The aim of this work is to compare the performance of these filters using the same ECG data and AED algorithm.

We used a database originally compiled to optimize and test the MC-RAMP filter. The database is composed of 184 shockable and 348 non-shockable out-of-hospital records, split in two equal sets for development and testing. Each record consisted of an initial 10s corrupted by a CPR artefact, followed by 10s of clean ECG. Sensitivities and specificities, before and after filtering, were evaluated using an offline version of a commercial AED algorithm.

The sensitivity and specificity before filtering for the whole dataset were 85.8% and 71.8% for the corrupt side and 98.9% and 99.4% for the clean side. The optimal working point of the dual-channel filters was determined using the training set. For the test set, the sensitivity and specificity of the corrupt side increased to 94.6% and 81.6% for both the LMS and the Kalman filters, for an accuracy of 86.1%. The sensitivity and specificity after filtering reported for the optimal working point of the MC-RAMP filter were 96.7% and 79.9%, for an accuracy of 85.7%.

This is the first unbiased comparison between dual and multi-channel CPR artefact suppression filters. The accuracy of the tested multi-channel and dual-channel filters is similar, but the dual-channel filters need fewer reference channels and a lower computational burden.