Automatic Identification of the Best Auscultation Area for the Estimation of the Time of Closure of Heart Valves through Multi-Source Phonocardiography

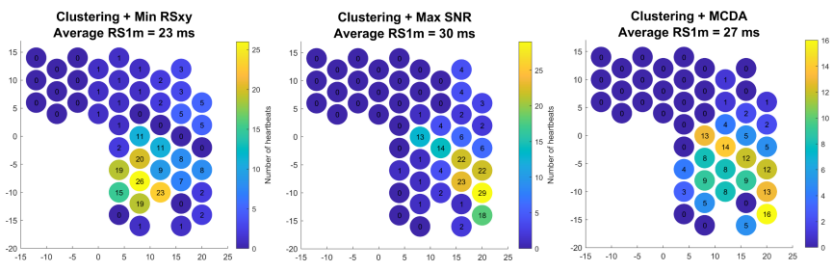
Noemi Giordano*, Gabriella Balestra, Marco Ghislieri, Marco Knaflitz, Samanta Rosati

Politecnico di Torino, Torino, Italy

In the latest years, multi-source phonocardiography (PCG) is gaining interest in relation to the home monitoring of cardiovascular diseases. An application of interest regards the monitoring of the time of closure of the four cardiac valves, which would enable the home follow-up of at-risk patients for heart failure. In fact, multi-source PCG could shift the problem of the identification of the best auscultation area from the recording phase (performed by the user) to the processing phase (performed by the algorithm).

In this work, we propose a hybrid system based on hierarchical clustering and Multi-Criteria Decision Analysis (MCDA) for automatically selecting the best auscultation area for the mentioned application through multi-source PCG. We simultaneously recorded 48 PCG signals from the subject's chest and divided them into morphologically homogenous groups using agglomerative hierarchical clustering, based on their correlation. Then, we explored three different approaches to select the best auscultation area, based respectively on the minimum latency, on the maximum signal-to-noise ratio, and on multiple criteria using ELECTRE III.

The results obtained on the follow-up of a healthy subject over five days show that a) the selection of the auscultation area using MCDA overcomes the limits of single-criteria approaches, b) the estimate of the times of closure using the proposed system is more robust than what obtained through its state-of-the-art single-source counterpart. These preliminary results confirm the potentiality of multi-source PCG to enable inexpert users to perform home recordings without the need for identifying the best auscultation area.



Number of times each microphone was selected using each tested approach for the identification of the best auscultation area (mitral valve).