Can multi-source phonocardiography enable inexperienced users to record heart sounds for telemonitoring applications? A comparative analysis

Noemi Giordano, Samanta Rosati, Gabriella Balestra, Marco Knaflitz

Politecnico di Torino
Torino, Italy

Introduction: The use of heart sounds in telemonitoring is extremely appealing due to portability, low cost, non-invasiveness. Nevertheless, the positioning of the electronic stethoscope is critical and prevents the use of phonocardiography (PCG) by inexperienced users. Multi-source PCG may provide a solution: by recording multiple signals from different points on the chest at high spatial resolution the problem of finding the best auscultation point is moved from the recording phase to the processing phase. In this study, we compare the quality of PCG signals recorded by inexperienced users through multi-source PCG against the quality of PCG signals recorded by an expert through a traditional single-source system.

Methods: We enrolled 42 volunteers with no technical nor clinical skill in auscultation. The volunteers were enrolled in couples. In each couple, volunteers recorded PCG signals on each other using a multi-sensor array that we designed for this purpose. An expert also recorded signals from each volunteer from the four typical auscultation areas, using a traditional single-source system. We assessed the quality of each signal by means of the Signal-to-Noise Ratio (SNR) of the two main heart sounds (S1 and S2).

Results: The SNR of S1 was found higher than the SNR of S2 over the mitral and tricuspid areas, and the other way round. The average SNR of the left-heart valves was found statistically equal between the two systems. The multi-source system outper-

Comparison on the mean SNR of the signals recorded at each auscultation area with each system

Cardiac valve	Single-ch SNR (dB)	Multi-ch SNR (dB)	p-value t test
Mitral	21.4	21.8	0.59
Tricuspid	21.0	22.9	0.008 *
Aortic	17.1	18.1	0.19
Pulmonary	18.9	22.4	< 0.001 *

formed the single-source on the right-heart valves. In the overall, the SNR of signals recorded by inexperienced users through the multi-source system was equal or higher than what recorded by an expert.

Conclusions: Experimental results show that the multi-source system enabled inexperienced users to record signals of equal or better quality. We believe that our results lay the foundations to apply multi-source PCG in homecare.