

OPTO-ELECTRIC CARDIOVASCULAR MONITORING

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INTRODUCTION: Continuous monitoring of the cardio vascular state is required in most of telemedecine, rehabilitation, and homecare applications. Nowadays, single-parameter monitors exist on the market (e.g. ECG, BP or SpO2 hollers) but none provides a global picture of the cardiovascular system. Commercial multi-parameter monitors exist mainly in hospital environments but are rarely exploitable in ambulatory because of their lack of integration and unobtrusiveness.

At CSEM we are investigating the possibility of continuously monitoring the cardiovascular system by observing a set of selected parameters. The fundamental selection criterion is the sensing technology: the parameters set must be entirely obtained by optical and electrical sensors localized at the chest region. In [1] we further justify this approach.

METHODS: A multimodal platform based on BIOPAC technology has been built at CSEM. The platform simultaneously records a set of three opto-electric signals: ECG, IPG and PPG (see Figure 1). From the synchronized raw signals, a set of cardiovascular parameters are computed in a MATLAB environment (see Table 1). An experimental protocol aims at inducing controlled changes in the cardiovascular system [2] consisting on a sequence of two handgrip periods at 40% MVC (Maximum Voluntary Contraction force). Each handgrip period lasts for two minutes.

Table 1. Set of cardiovascular parameters

	Acronym	Source signal	Requires calibration
Heart Rate	HR	ECG	No
Pre Ejection Period	PEP	ECG, IPG	No
Stroke Volume	SV	IPG	Yes
Cardiac Output	CO	ECG, IPG	Yes
Pulse Transit Time	PTT	ECG, PPG	Yes
Pulse Amplitude	PA	IPG	No

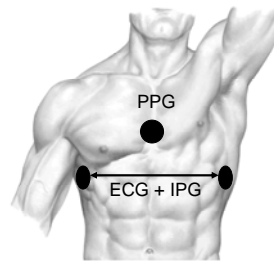


Fig. 1: Opto-electric monitoring setup. ECG: Electro-Cardiograph, IPG: Impedance-Plethysmograph, PPG: Photo-Plethysmograph

RESULTS: Figure 2 plots the evolution of the computed cardiovascular parameters during a handgrip experiment. The platform successfully detects changes induced to the cardiovascular system, especially to HR, SV and PTT.

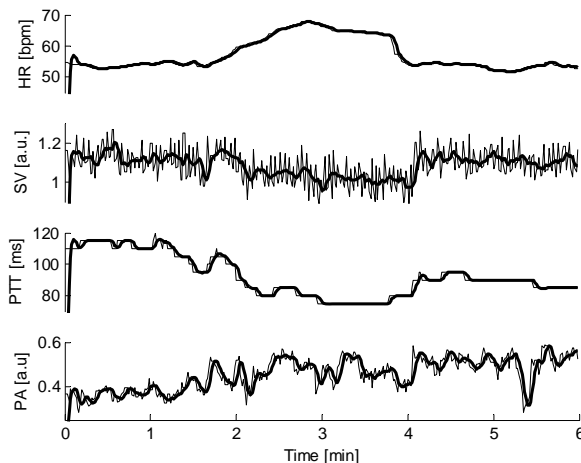


Fig. 2: Temporal evolution of 4 selected cardiovascular parameters.

DISCUSSION & CONCLUSIONS: A platform measuring a set of cardiovascular variables that requires only optical and electrical sensing at the chest region has been constructed and preliminary experimental data has been recorded.

REFERENCES: ¹ O. Chételat et al. (2006) *Continuous Multi-parameter Health Monitoring System*, Proc. World Congress on Medical Physics and Biomedical Engineering. ² J. Hisdal et al. (2004) *Regulation of arterial blood pressure in humans during isometric muscle contraction and lower body negative pressure*, Eur. J. Appl. Physiol 91, pp 336-341