Calibration and validation of homeostasis parameters estimates produced by a DSP embedded in a wheelchair

Publisher: IEEE

Eduardo C. Pinheiro ; Octavian A. Postolache ; Pedro Silva Girão **All Authors**

Abstract: Ballistocardiogram, capacitive electrocardiogram, and photoplethysmogram (PPG) sensors were embedded in a wheelchair together with a digital signal processor (DSP) with W... **View more**

Metadata

Abstract:
Ballistocardiogram, capacitive electrocardiogram, and photoplethysmogram (PPG) sensors were embedded in a wheelchair together with a digital signal processor (DSP) with Wi-Fi capabilities. This setup allows monitoring of some homeostasis parameters of the wheelchair user, namely heart rate (HR), pulse arrival and transit times, and oxygen saturation (SpO_2). Ten subjects tested the wheelchair capabilities. SpO_2 and HR obtained from the PPG of reference equipment were also recorded for comparative analysis. This paper reports the results of the algorithms developed for HR estimation, for all the signals, and for SpO_2 from the PPG. From the data of the ten subjects the algorithms had their parameters calibrated, and presented an average RMS error of 1.903% for SpO_2, with the best value being 0.024%. The most unstable signal is the BCG from where the global calibration provides an HR estimate with an average 4.73 bpm error. The algorithms created were confirmed valid, and the signals from the hardware setup can be used to provide estimates with significant accuracy in heart rate estimation, but needing personalized calibration in the SpO_2 case.

Published in: 2013 IEEE International Instrumentation and Measurement Technology Conference (I2MTC)

Date of Conference: 6-9 May 2013 **INSPEC Accession Number:** 13662590

Date Added to IEEE *Xplore*: 15 July 2013 **DOI:** 10.1109/I2MTC.2013.6555417

ISBN Information:

Publisher: IEEE

Print ISSN: 1091-5281

Conference Location: Minneapolis, MN, USA

Contents

Mobile, wearable, or embedded systems providing continuous cardiac monitoring are being investigated for some time, and have seen many implementations [1]–[6]. Its interest relies on their low interference with daily life activities, while avoiding the inconveniences and stress of a formal clinical evaluation on an hospital, and their connectivity to e-health information systems. However, generally only one physiological signal is monitored, often supplemented by accelerometry, and few results are provided regarding the patient's state [7]–[15]. Specifically in chairs or wheelchairs, where physical space is available, and embedding several sensors is possible [16], [17]. Improvements on the state of the art are attainable, as the known implementations on wheelchairs monitor only one cardiac signal, and do not provide a stand alone monitoring solution, or only with limited signal processing data storage and communication capabilities [14], [15], [26].