World Congress on
Hypertension and Cardiovascular Diseases
November 21-22, 2018 | Paris, France

24H unobtrusive blood pressure monitoring and health maps in treating hypertension

Foroohar Foroozan

Analog Devices Inc.(ADI), Canada

co-author: **Ehud Baron**
X-Cardio KK, Japan

Problem: Continuously monitoring the Blood Pressure (BP), specially for people of advanced age and those who are at a high risk of developing cardiac disease is very important. Currently, continuous BP measurements, including nocturnal, require surgical insertion of an intra-arterial monitor, only occurring in an ICU environment. Non-invasive BP measurements are limited to cumbersome products requiring deliberate inflation & producing only spot measurements, often negatively impacted erroneous procedures during measurement. Medical providers, patients and pharma need continuous, real life measurements without expensive, bulky invasive equipments. In this work, 24H unobtrusive monitoring of cardiovascular health is implemented using wrist-based Photoplethysmography (PPG) signals, in which we produce 24H BP graphs and Personal Health Maps (PHM).

Methodology: We suggest PHM for each patient to provide at a glance the position of the patient in the Health Space 24H. The algorithm is based on Fuzzy clustering, where each patient is assigned with a different level of membership in different pathological and healthy conditions. The PHM shows the trace of a patient's PPG pulse shape during day and night in one glance. In one study in Calcutta hospital, 30 hypertensive and diabetic patients were monitored at home 24H both with an Ambulatory Blood Pressure Monitoring (ABPM) device which records the BP every 15 min together with a continuous PPG recordings in order to estimate the BP and Cardiac Output (CO) continuously. In a second clinical trial, we compared our Hemodynamics prediction to that of a continuous Hemodynamics CNAP device, during Hemodialysis in Fresenius Kidney Center, in St. Louis hospital. Using 2-4 light wavelengths allowed us also to interrogate the capillary bed at different penetration levels to estimate features related to the microcirculation.

Findings: We implemented Fuzzy clustering algorithm to cluster the pulse shapes in the feature space. We discovered that different health conditions fell into different clusters and it changes during 24H.

Conclusions & Significance: We showed that different health conditions can be defined by the PPG pulse shape clustering, which also generates a continuous Health space. Cluster centroids that represent various pulse shapes belong to different health conditions. This provides a powerful tool to monitor progress or deterioration of a patient in a quantitative way. It is quite crucial for people suffering from hypertension to monitor their BP continuously and get timely medical intervention, so that serious cardiovascular complications shall be prevented. This method can also solve the problem of nocturnal cardiac monitoring at home.

Biography

Foroohar Foroozan is system software and signal processing scientist at Analog Devices Inc. (ADI) leading the algorithm design for vital signs and in-home monitoring systems for the healthcare business unit in Toronto. The mission of this technology development group is to deliver the embedded platform, cloud, and analytics technologies required to meet the ADI IoT product and service ambitions. She is also collaborating with the Echo2Bits healthcare team for Point-of-Care ultrasound imaging systems. She was a postdoctoral fellow at Sunnybrook Research Institute working on 3D super-resolution ultrasound imaging for brain vascular mapping from 2012 to 2013 with a PCT patent pending. She was also a lecturer at the University of Ontario Institute of Technology, teaching both graduate courses from 2011 to 2012. She received her PhD degree in computer science from Lassonde School of Engineering, York University, Toronto, Canada in 2011. Her area of interest is in signal processing and algorithms in biomedical systems with focus on body area sensors for vital signs systems, in-home monitoring systems for assisted living and biomedical imaging. Dr. Foroozan's work on compact ultrasound imaging system was awarded at the Sunnybrook-Schulich Innovation program in 2014, with a PCT patent. She is a member of the Professional Engineering Society of Ontario (PEng.) and a senior member of the IEEE.

Foroohar.Foroozan@analog.com