# A Beat-to-Beat P-Wave Analysis in a Healthy Population

Valentina DA Corino*, Ioanna Chouvarda, Nicos Maglaveras and Luca T Mainardi

Department of Bioengineering, Politecnico di Milano, Milano, Italy

Changes in P wave morphology have been documented between patients with and without paroxysmal atrial fibrillation and in healthy subjects of different age. However, these changes were investigated using average P waves, obtained from the signal averaged ECG. Aim of this study is to explore and quantify possible beat-to-beat variations in P wave characteristics. Two-minute X-lead ECG recordings (1000Hz) of 54 healthy subjects (mean age 40 $\pm$ 14 years, range 17-69 years) were analyzed. Data were obtained from Physionet database. Beginning and end of P waves were located by means of ecgpuwave software. All P waves were aligned against a reference P wave, here defined as the first normal P wave of the ECG; waves poorly cross-correlated with the other beats were rejected. Each valid P wave was fitted by a Gaussian function (defined by three parameters: mean , standard deviation and amplitude A) whose parameter variations were investigated over two minutes window. To assess the method reliability, the normalized root mean squared error (NRMSE) between each P wave and its fitting was computed. To evaluate the variability of the estimated parameters, the coefficient of variation (CV), defined as the ratio of the standard deviation to the mean, was computed. Despite its simplicity, the proposed model was able to represent the P actual waves, being the mean NRMSE 0.047 $\pm$ 0.030 (range 0.012 0.140). A variability was found in all patients for both the parameters A and , reflecting P waves amplitude and duration, respectively. The mean CV of A was 0.087 $\pm$ 0.050 (range 0.032 0.253). CV of was 0.093 $\pm$ 0.053 (range 0.028 0.27). Finally, no correlation was found between the average model parameters and subjects age. These preliminary results lay the foundation for future beat-to-beat P wave analysis in patients with atrial conduction pathologies.