

**PhD LAUREANTI RITA**

**November 16th 2020 - h: 15.00**

**Aula Seminari – Alario**

**Modalità Teleconferenza Microsoft Teams**

**PhD student:** LAUREANTI RITA – XXXII Cycle

**Thesis title:** *Novel ECG feature extraction methods and Big data analytics tools for the screening of Atrial Fibrillation population recordings*

**Advisor:** Prof. LUCA MAINARDI

**Co-Advisor:** Prof. VALENTINA CORINO

**Co-Advisor:** Prof. ANGELO AURICCHIO

**Abstract:**

Atrial fibrillation (AF) is a common heart arrhythmia characterized by a pathological, uncoordinated atrial depolarization. AF causes structural and electrical remodeling in the atria, thus favouring the persistence and worsening of the arrhythmia over time. Indeed, AF usually starts from a paroxysmal form, in which the normal sinus rhythm (SR) is restored by itself within seven days from onset. Paroxysmal AF eventually progresses to persistent (an external intervention is needed to restore SR) and permanent AF (the restoring of SR is not indicated, has failed or has not been attempted). The presence of AF increases the risk of suffering from adverse events such as myocardial infarction, heart failure and stroke, as well as the risk of death. A variety of ECG parameters have been presented in literature to identify patients prone to develop AF, considering both atrial and ventricular activity. Less information is present about the possibility to use such parameters to discriminate between the different stages of AF. This knowledge could be useful to select the best treatment for a new patient and perform longterm monitoring of the pathology. In addition, while several studies consistently demonstrated the deteriorating effect of irregular ventricular contractions during AF on hemodynamics, less is known about the prognostic value of the atrial activity and its variability. The characteristics of the atrial signal during AF have been used to assess the probability to restore sinus rhythm (spontaneously AF termination or probability of successful cardioversion/ablation). However, the ability of these parameters to predict adverse events has been assessed only in a cohort of patients with congestive heart failure. Even less is known about P-wave variability parameters and the risk of adverse outcome. Aim of the thesis is i) to assess whether ECG-related parameters present significant differences among AF types, and ii) to evaluate the association between atrial ECG parameters and the risk of suffering from adverse events related to AF, such as stroke, heart failure, myocardial infarction and cardiovascular death. Being the AF marked by an irregular atrial activity, the thesis assessed not only the atrial parameter themselves but also their variability over 5 minutes, suggesting novel features for the atrial analysis of AF. For the recordings with SR as main rhythm, the spatio-temporal beat-to-beat P-wave variability was computed. For ECGs with AF, after cancellation of the ventricular activity, the fibrillatory signal was analyzed in both the frequency (atrial fibrillatory rate, organization index, Exponential Decay) and time domain (Sample Entropy, standard deviation and amplitude of the fibrillatory waves on windows of 10 seconds, together with their median absolute deviation across all windows). The analysis was performed on the Swiss-AF population, a cohort with 2415 enrolled patients with paroxysmal, persistent or permanent AF, availability of 5-minute 16-lead ECGs and information about occurrence of adverse events in follow-up. The results indicate that atrial parameters show significant differences between AF types. In particular, during SR the beat-to-beat P-wave variability was significantly higher in the persistent group than in the paroxysmal one (e.g.  $0.33 \pm 0.22$  vs  $0.30 \pm 0.19$ ,  $p=0.003$  in V1). For recordings in AF, the atrial fibrillatory rate and the organization index showed significant differences between the paroxysmal and persistent or permanent type. In the second part of the thesis, significant associations were found between occurrence of adverse events in follow-up and atrial parameters, such as the association between Exponential Decay lower than 0.17 and risk of cardiovascular death (HR=2.10, 95% CI 1.26-3.50,  $p=0.004$ ) for recordings with AF and the association between PQ longer than 197 ms and heart failure (HR=2.14 95% CI 1.26-3.62,  $p=0.005$ ) for recordings in SR. In summary, this thesis aims to present a comprehensive study on the ECG metrics able to describe the abnormal atrial activation that characterizes AF in order to evaluate their effectiveness in tailoring treatment and predicting prognosis in the clinical context. The focus on atrial parameters and their variability allow the direct assessment of the substrate that initiates and maintains AF, playing a fundamental role in the AF analysis.

COMMITTEE MEMBERS		
<b>Prof. Pietro Bonizzi</b>	<b>Prof. Pyotr Platonov</b>	<b>Prof. Pietro Cerveri</b>
<b>Maastricht University, The Netherlands</b>	<b>Lund University Sweden</b>	<b>Politecnico di Milano</b>