



University of Molise

Department of Biosciences and Territory

Bachelor Thesis

# Global and Local Prediction in Automatic detection of Atrial Fibrillation

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December, 2019

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# Chapter 1

## Introduction

### 1.1 What is the Atrial Fibrillation?

Atrial fibrillation, also abbreviated with AF or A-Fib, is an abnormal heart rhythm that happens when electrical impulses fire off in the atria (Figure 1.1), from different spots without being organized. Characterized by rapid and irregular beating, caused by the chambers of the heart twitching [1]. This arrhythmia is associated with an increased risk of stroke, infact the proportion of strokes associated with AF increases from 6.6%, for ages 50 to 59 years, to 36.2% for ages 80 to 89 years [2]. Other risks are heart failure and even dementia [3].

[Cambiare cit](#)

The disease is classified by doctors based on how long it lasts or based on the cause. The treatment will be different for each kind [4]:

- **Paroxysmal** (holiday heart syndrome): an episode of AF, the duration of whose may be a few minutes or a few days, but which tends to be

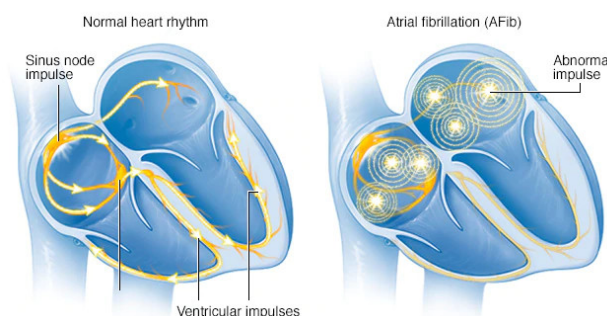


Figure 1.1: A normal heart beat on the left, an AF heart beat on the right. Image from mayoclinic.org

below the week. Usually, treatment is not needed;

- **Persistent:** the disease lasts longer than a week and it can stop on its own, or a specific medicine or treatment is needed. If the latter does not work, doctors opt for the electrical cardioversion, which is a low-voltage current used to reset the normal rhythm;
- **Permanent:** also called chronic, cannot be treated. The doctor decides for a long term medication to reduce the odds of associated health conditions.

## 1.2 Causes and Symptoms

There are many possible causes of the condition, some are controllable, others are not. Cardiovascular factors play a big role: high blood pressure, heart valve disease, congenital heart disease and even previous heart surgery. But difficulties in breathing are a key factor too, in other words obesity, obstructive sleep apnea [5]. Alcohol consumption and tobacco smoking are associated with an increased risk of developing atrial fibrillation [6, 7]. Other factors are genetics, ageing, a sedentary lifestyle and diabetes [8, 9].

The person often feels an abnormal beating that starts to become longer and constant. There could be heart palpitations, shortness of breath, chest pain, light-headedness, or fainting [10]. But the biggest problem is that often these kind of episodes are asymptomatic [3], in fact sometimes first diagnosed when patients present a stroke [11].

## 1.3 Diagnosis

A doctor to diagnose AF could check your signs and symptoms, together with your medical history and conduct different kind of tests :

Inserire cit

- **Electrocardiogram** (ECG or EKG) is the process through which a recording of the electrical activity of the patient's heart is made. To measure the electrical signals as they travel, multiple small sensors, called electrodes, are attached to the body. This test plays a key role among all the other tools used. A more in depth explanation will be offered in Chapter 2.
- **Holter monitor** is a portable ECG device that can be carried in a pocket or even worn on a shoulder strap or a belt. The monitor will check the heart's activity for 24 hours, sometimes even longer. It is a

common practice to utilize the device when there is a strong suspect about a Paroxysmal-AF but an ECG during an office visit detects only a regular rhythm.

- **Event recorder** is an other kind of ECG portable device that is meant to monitor the heart beat over a few weeks to a few months. When the patient feels a symptom, then the button should be pressed to let the device memorize an ECG strip of the preceding few minutes and following few minutes.
- **Echocardiogram** is a non-invasive test that uses ultrasound waves to scan the heart and get moving pictures of the organ. The doctors aim to find problems in the valves, in the size of the left and right atrial or more general structural heart disease or blood clots.
- **Blood tests** are used to check any thyroid problems or other substances in the patient's blood that may lead to AF.
- **Stress test** can help the doctor in the task of finding AF. The reason is that some individual with the disease do well in normal activity, but not with exertion. Moreover the nature of the symptoms can be understood.
- **Chest X-ray** help to see the condition of lungs and heart of a specific patient. In general it's used if a pulmonary cause of AF is suggested or if conditions like congestive heart failure are suspected.

The first type of test, the ECG, is an investigation performed routinely whenever an irregular heart beat is suspected. And it can be done in the office and later even with portable device, thus it's a relevant tool through which an automatic detection of atrial fibrillation can be implemented. The Chapter 2 contains a more detailed description of what an ECG does, and a state of the art approach will be discussed and improved.





# Chapter 2

## Global prediction

### 2.1 What is an ECG?

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Electrocardiogram (ECG or EKG) is the process through which a recording of the electrical activity of the patient's heart is recorded. To measure the electrical signals as they travel, multiple small sensors, called electrodes, are attached to the body. If 10 electrodes are used, then a 12 ECG leads forms, with each lead measuring specific electric potential difference

### 2.2 Automatic detection of AF

### 2.3



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