

# Automatic Location of Ventricular Arrhythmia using Implantable Defibrillator Stored Electrograms

Margarita Sanromán-Junquera\*, Inmaculada Mora-Jiménez, Jesús Almendral, Estrella Everss, Antonio Caamaño-Fernández, Felipe Atienza, Loreto Castilla and José Luis Rojo-Álvarez

Signal Theory and Communications Department, Rey Juan Carlos University, Spain, Fuenlabrada, Madrid, Spain

**Background.** Electrograms (EGM) stored in Implantable Cardioverter Defibrillator (ICD) during ventricular tachycardia episodes have recently been shown to convey valuable information for the identification of the anatomical origin of the arrhythmia and subsequent ablation therapy.

**Methods.** We developed an automatic procedure for estimating the focal origin of the arrhythmia by analyzing the EGM waveforms. A clinical protocol was designed for validation, consisting of electrical pacing from different spatial locations in the left ventricle, in which the spatial coordinates of the pacing electrode were known by the use of a sequential navigation system. EGMs from can-coil lead configuration were stored in the ICD for 25 patients ( $18 \pm 10.1$  EGM per patient). Several machine learning classifiers ( $k$  nearest neighbors, radial basis function, and multilayer perceptron), were implemented, whose input space was given by the 201 samples (340 ms) of the template for each pacing location, and by a set of simple parameters selected according to clinical criteria. The target output was set by considering the heart division in three main planes, hence giving jointly 8 possible classification regions (octants). To estimate the generalization performance, a leave-one-patient-out strategy was implemented.

**Results.** Location accuracy reached, averaged over 10 runs,  $73.1 \pm 0.3 \%$ ,  $58.4 \pm 0.1 \%$ ,  $57.5 \pm 1.8 \%$  (for binary classification in terms of main planes), and for octant identification with multioutput classification reached  $36.3 \pm 1.2 \%$  (note that the random 8-output classifier average accuracy rate is 12.5%).

**Conclusion.** The estimation of the arrhythmia location can be addressed by analyzing the EGM waveform and features using learning from samples techniques.