Heterogeneity Quantification of Electrophysiological Signal Propagation in High-Density Multielectrode Recordings

Lucía Pancorbo[1,2], Samuel Ruipérez-Campillo[1,3,4], José Millet[1], Francisco Castells[1]

[1]Universitat Politècnica de València, [2]Universidad Carlos III de Madrid, [3]Stanford University, [4]ETH Zurich.

Introduction: High-density catheters, such as Advisor HD Grid, are highly relevant for clinical use given their ability to acquire omnipolar electrograms. This technology provides a claimed orientation-independent representation of the intracardiac signals. We propose a novel metric to evaluate the heterogeneity of cardiac substrate by using vector maps derived from omnipolar electrograms. This metric determines the level of disorganisation of electrical propagation, having the potential to characterise cardiac tissue under the catheter, and may therefore help diagnosis and treatment of arrhythmias.

Methods: The heterogeneity metric is based on the computation and comparison of the angles of propagation in vector map representations of the electrophysiological signals. We performed tests on propagation maps of experimental recordings with and without electrical stimulation. Given the assumption that the stimulation decreases the level of heterogeneity by aligning the vectors, we hypothesise that the proposed parameter can distinguish between the two groups and perform statistical analysis accordingly.

Results: We observed a significant difference ($p < 0.001$) between the heterogeneity values of maps in the stimulated and the basal group. Additionally, the Receiver Operating Characteristic (ROC) curve was computed on the binary classification basal/stimulated, obtaining an AUC of 0.996 and 100% accuracy in identifying recordings with stimulation for the optimal threshold found.

Conclusion: The proposed heterogeneity metric effectively differentiates stimulated and non-stimulated epicardial tissue, which may provide electrophysiologists with valuable information for managing arrhythmias, underscoring the clinical relevance of the metric as a tool in cardiac electrophysiology.

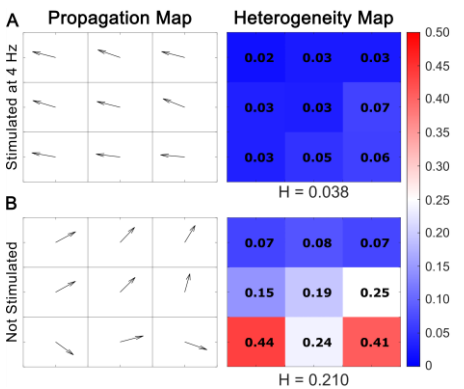

Figure. *Examples of heterogeneity maps displaying the heterogeneity value H.* **A**. *Results for a recording stimulated at 4 Hz. On the left, the propagation vector map; right, the heterogeneity map.* **B.** *Idem for a recording without stimulation.*