Dominant Frequency Estimation in AF from ECGI

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Non-invasive estimation of high frequency activation regions in atrial fibrillation (AF) may have an important role in patient stratification and ablation guidance. This work presents a methodology to robustly estimate DF maps in ECGI, where the uncertainty associated to the estimates is modelled making use of a set of ECGI solutions obtained from Tikhonov 0-order regularization with a range of different lambda parameters (DF-LR).
The proposed DF-LR method was compared to the DFs obtained from Tikhonov 0-order regularization when selecting the lambda value from the standard L-curve optimization method (DF-LC). Specifically, the highest dominant frequency (HDF) found with both methods was tested in 2 AF simulations where the gold standard activation frequencies were extracted from the simulated transmembrane potentials. In addition, the reproducibility of the DF maps were studied in a clinical case using ECGI signals from a persistent AF patient. In this case, mean absolute difference between DF maps obtained in consecutive time windows was computed to quantify the reproducibility of the methods LC, LR, and LR in high confidence atrial regions.
DF-LR method overcame the DF-LC in terms of HDF sensitivity (see table 1). Furthermore, the mean absolute difference between consecutive DF maps was lower in DF-LR method (0.64±0.34Hz vs 1.38±0.11 Hz) showing higher reproducibility.

Table 1. Sensitivity and specificity of the LC and LR methods for each of the simulations.

	Sensitivity		**Specificity**	
Methods	OLC	LR	OLC	LR
Sim. 1	0.010	0.929	0.995	0.782
Sim. 2	0.000	0.889	0.984	0.920

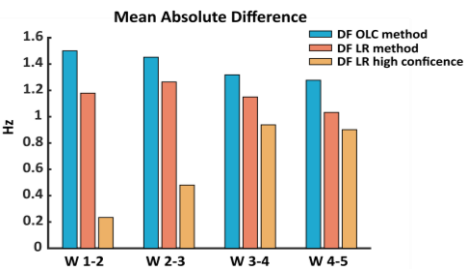

Figure 1. Mean absolute difference of DF maps in consecutive time windows.