# Whole chamber Conduction Velocity Estimation during Arrhythmias

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**Introduction:** Conduction velocity (CV) heterogeneities is a well-known mechanism of cardiac arrhythmia initiation and perpetuation. Nevertheless, technological solutions are needed to characterize CV in clinical practice.

**Aim:** This work presents a method to measure the CV on complicated surfaces (e.g. atria) both during sinus rhythm and atrial fibrillation (AF).

**Methods:** CV was estimated on realistic complex atrial geometries was performed by first determining the direction of the excitation wave in each pixel of the geometry from the gradient of the isochrones and then remeshing the complex realistic surface onto a regular 2D structure (geometric image) by applying a spherical parametrization. The proposed methodology was validated by using spherical and realistic 3D mathematical models with geodesic generated isochrones in which gold standard CVs were measurable. In addition, the methodology was tested by comparing CV estimations during sinus rhythm and AF on realistic simulations with imposed left atrial remodeling. Finally, human ECGI recordings from paroxysmal AF patients were used to illustrate a proof of concept clinical applicability.

**Results:** Comparison between gold standard CVs and those measured with our proposed method resulted in a spatial correlation of 97.2% for spheres and 90.6% for realistic atrial anatomies. For remodeled atrial simulations, our method obtained a linear relationship between the CV measured during sinus rhythm and AF of $R^2$=0.91, with lowest CVs corresponding to the remodeled area. Finally, CVs measured from clinical ECGI recording showed CVs ranging from 40 to 160 cm/s, with slowest CVs on the left pulmonary veins and the left atrial appendage (Fig).

**Conclusions:** Our proposed method allows the estimation of CVs during simple and fibrillatory patterns on realistic atrial geometries and could serve to stratify AF patients.