# Volumetric Source Imaging for Enhanced Non-invasive Localization of Atrial Septal Ectopic Beats

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**Introduction.** Precise non-invasive localization of ectopic triggers is essential for successful catheter ablation. However, conventional surface-based ECGI is limited by its epicardial-only formulation, which frequently misprojects deep intramural sources—such as those in the interatrial septum—onto the atrial free walls. We evaluate Volumetric Source Imaging (VSI) to overcome this by reconstructing electrical activity throughout the entire 3D myocardial volume.

**Methods.** Accuracy was assessed via *in-silico* simulations (20 geometries) and clinical septal pacing (ACORYS system). Surface ECGI and VSI were compared using Tikhonov regularization, with earliest activation sites (EAS) estimated via a Bayesian framework. Anatomy was derived from Statistical Shape Models (SSM) to allow for a high-precision workflow without the need for MRI or CT imaging.

**Results.** VSI significantly improved precision *in-silico*, reducing mean localization error from 37.2 ± 13.0 mm (ECGI) to 21.6 ± 11.7 mm (VSI) ($p < 0.001$). VSI achieved <15 mm error in 45% of cases. Clinically, VSI correctly localized the septal EAS, whereas surface ECGI failed due to right atrial free-wall projection artifacts.

**Conclusions.** VSI corrects systematic projection errors inherent to surface ECGI, providing a physiologically consistent representation of intramural activity. This enhances non-invasive planning for septal arrhythmias using imageless workflows.