Relationship Between Cardiac Isochrones and its Mean Anatomical Position in the Heart: the *CineECG* Method

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Background: The standard 12-lead ECG is a fundamental clinical tool to provide direct insight into cardiac electrical activity. *CineECG* is a novel approach to ECG analysis that relates cardiac electrical activity to anatomy by computing the mean temporo-spatial isochrone(mTSI) trajectory. Since its introduction, *CineECG* has been reported to be reliable for the detection of Brugada Type-I and conduction disorders, but the relationship between cardiac isochrones and the mTSI trajectory has not yet been explored.

Methods: His-Purkinje mediated activation sequences for normal and conduction disorder cases were simulated using the fastest route algorithm with multiple endocardial foci. The trajectory of the average simulated activation position(*ASAP*) during QRS was computed as the average position of activation for each 5 ms time interval per simulated activation sequences. A boundary element method forward model based on a CT-derived subject-specific heart/torso model(21y male) was used to compute the QRS interval of the 12-lead ECG signals of the simulated ventricular activity, and the simulated ECGs were used to compute mTSI trajectories.

Results: Sixteen activation sequences were simulated to compute the *ASAP* and mTSI-trajectories(3 examples in the figure). The average distance between the mTSI and *ASAP* during the QRS interval was 18.4±3.2mm. The initial part of the mTSI trajectory always indicated a transseptal vector directed to the side of the septum which was activated second. The terminal part of the mTSI trajectory was always directed towards the region of late activation, most clearly visible in the conduction disorder cases.

Conclusion: *CineECG* shows a significant ability to recover significant features of the underlying activation isochrones. This relationship of *CineECG* to cardiac isochrones provides insight into the observed diagnostic accuracy and potential for clinical use of *CineECG*. Ongoing research focuses on the in-vivo comparison of mTSI to *ASAP* and on the sensitivity of the mTSI computation to electrode positions.

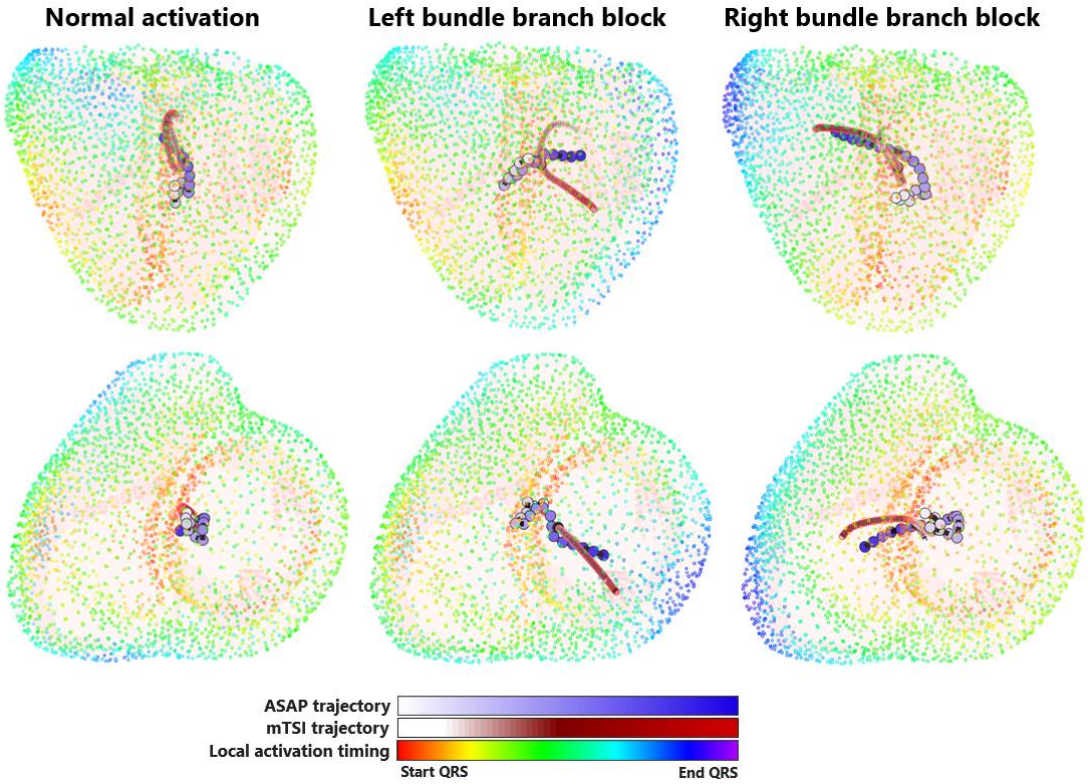

Figure *- Three examples of calculated mTSI trajectories (white-red), average simulated activation position (ASAP) trajectories (white-blue) and simulated activation sequences (red-purple). Representative examples of normal activation (left), a left bundle branch block (middle) and a right bundle branch block (right) are displayed in both four chamber (upper row) and apical (lower row) views*