# Optimizing the Reconstruction of Cardiac Potentials Using a Novel High Resolution Pericardiac Cage

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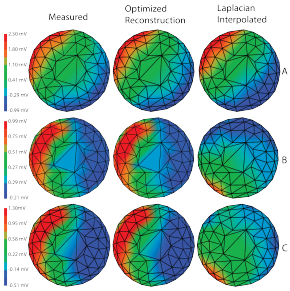
Introduction: Experimental preparations in which cardiac and torso recordings are made simultaneously typically do not have uniform sampling around the entire surface of the heart. To fill in the resulting gaps in coverage, signals captured from the sampled region are extended to the unsampled region of the heart before being utilized in computational models. The resulting errors have never been evaluated systematically. We explored this relationship using a novel experimental preparation, and compared the resulting measurements against a set of interpolation and optimization methods.]

Methods: Measurements came from a modified Langendorff preparation in which we placed a rigid, heart shaped pericardiac cage electrode array around an isolated canine heart within an electrolytic-torso tank. Using the measured cage potentials we optimized a reconstruction from the subset of the cage below the base of the heart (ventricular) to the subset above it (atrial). This optimization minimized the difference between the reconstructed and measured signals. We then compared the reconstruction to a spatial Laplacian interpolation of the same potentials.

Results: Qualitative results show a high degree of agreement between optimized reconstructed potentials and measured potentials whereas the Laplacian interpolation resulted in poorer reconstructions in most cases. Calculated mean and maximum error were lower for optimization based approaches than spatial Laplacian interpolation.




Comparison of reconstruction methods 50% into the QRS. Row A: ventricular paced beat, row B: sinus beat, Row C: atrial Paced beat.

Discussion: In this study we aimed to utilize novel pericardiac cage recordings to investigate interpolation strategies from sampled signals to unsampled signals. We demonstrate that the sampled ventricular subset of signals is sufficient to reconstruct the atrial subset but that Laplacian interpolation does not achieve the level of accuracy that is possible.