

# INTER-MODALITY REGISTRATION TO GUIDE CARDIAC PROCEDURES

McManigle J.E. (1,2), Arai A. (2), and Noble J.A. (1)

(1) University of Oxford, UK (2) National Institutes of Health, USA

## Abstract

Percutaneous cardiac procedures are currently guided by real-time echocardiography (RT-US) and fluoroscopy. However, targets of these procedures are often identified by cardiac magnetic resonance (CMR) and x-ray computed tomography (CT) imaging. This project introduces wavelet fusion echo images as an intermediate registration step to permit rapid registration from intra-operative echo to pre-operative CMR and CT. This may allow beating-heart guidance with these more effective modalities.

## Motivation

Heart disease is a leading cause of death worldwide. Established and developing percutaneous techniques promise safe, effective treatments of coronary, valvular, and electrophysiologic derangements. These procedures are guided by ultrasound and fluoroscopy. However, features such as myocardial perfusion, scar tissue, and calcification are best visualized with CMR and CT images, which are incompatible with catheterization laboratories. Rapid registration between RT-US and CMR or CT images would allow more effective guidance and shorter, less dangerous procedures.

## Aim

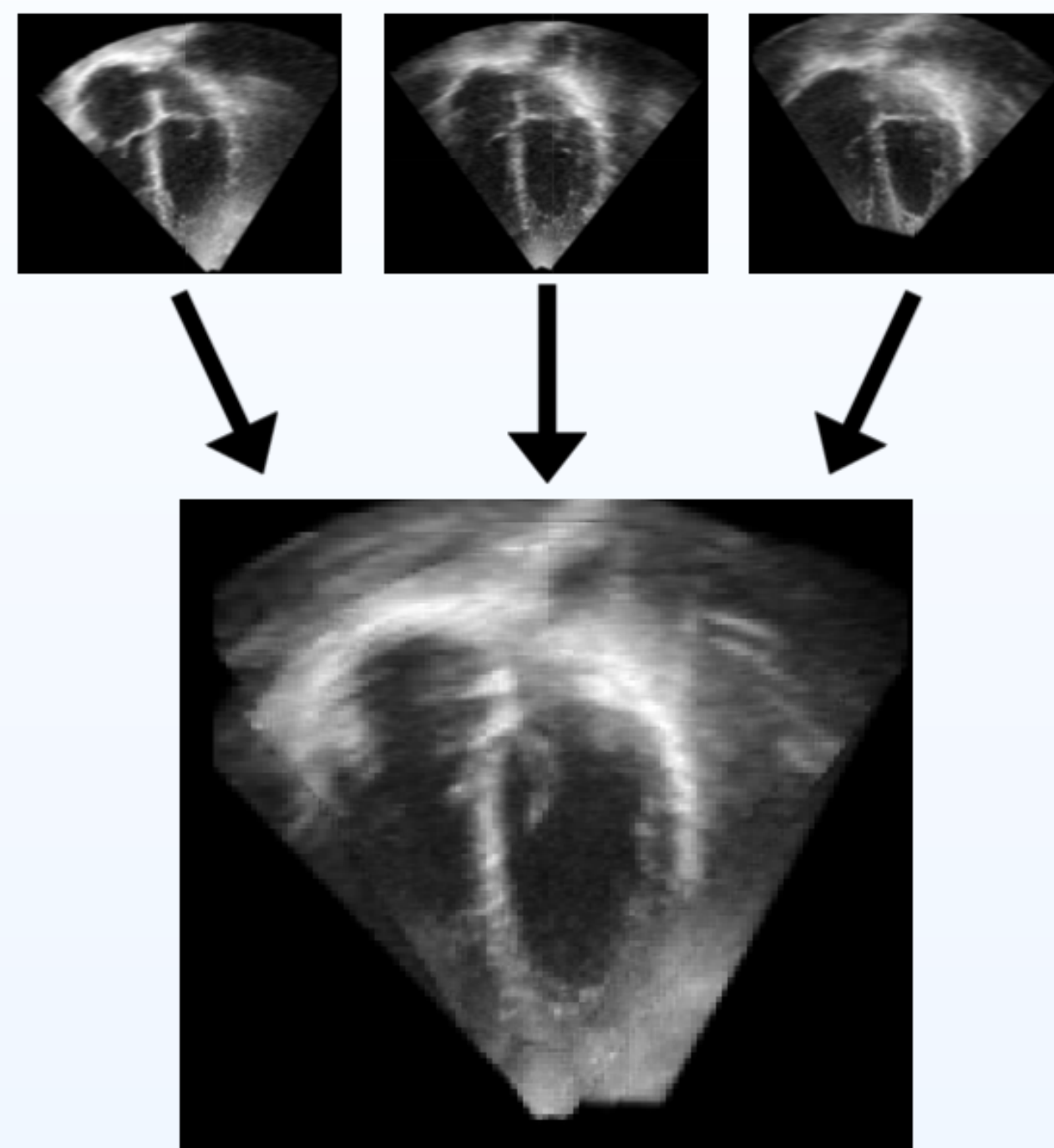
Introduce pre-operative 3D+t fusion echo images as an intermediate registration step between live 3D US and pre-op CMR and CT.

## References

- [1] Rajpoot, K., et al., Multiview RT3D echocardiography image fusion, in *5th Functional Imaging and Modelling of the Heart*, 2009
- [2] Thirion, J.P., Image matching as a diffusion process, in *Medical Image Analysis* 2(3):243-260, 1998

## Fusion Echo

Echocardiogram images often suffer from narrow field-of-view and loss of signal or artifacts at the boundaries of the image. By fusing multiple views with a wavelet transform, these disadvantages are minimized [1].



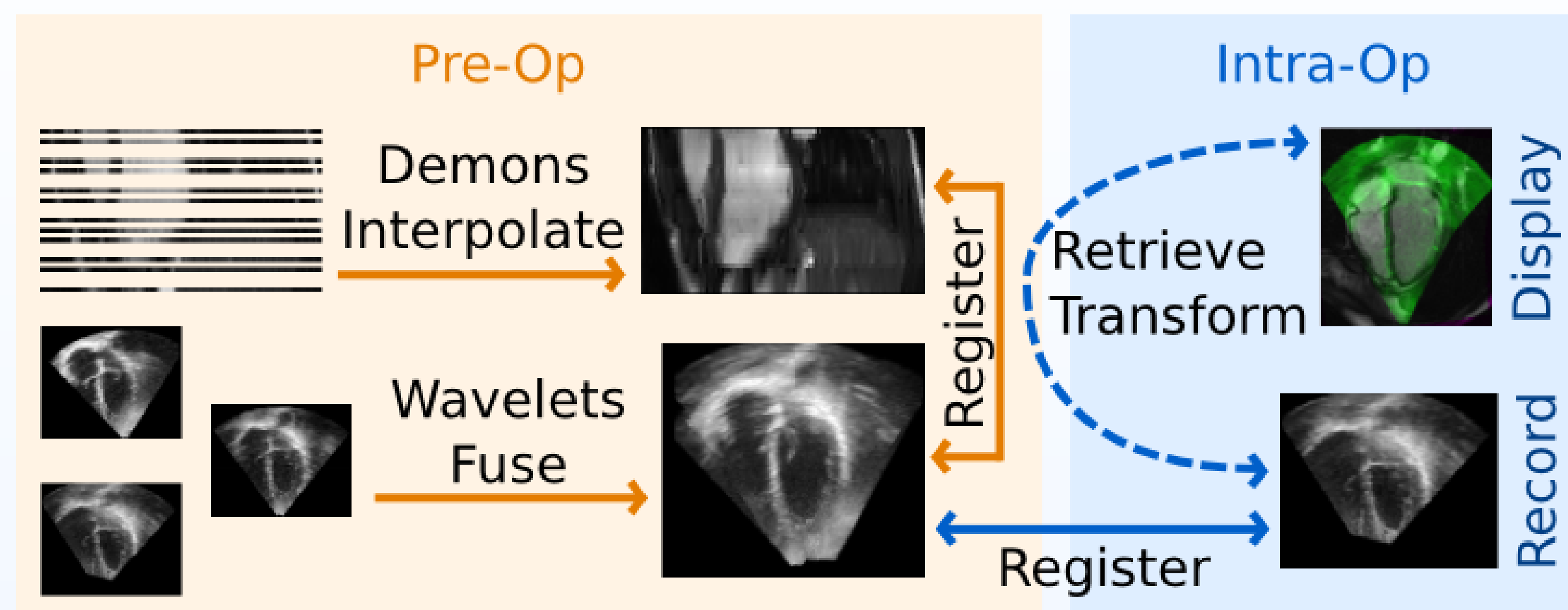
## CMR Interpolation

Clinical CMR images are often sparse in one spatial dimension (ie multiple 2D+t slices). Demons registration was used to interpolate intermediate slices, generating pseudo-3D data appropriate for registration [2].



## Two-Step Registration

Current efforts are directed at aligning fusion echo with interpolated 3D+t MR data using a mutual information metric. Intra-operative RT-US images will be registered to fusion echo images using a fast rigid transform algorithm.



The two registration steps will be convolved to a fusion echo-to-CMR transform, which is applied to generate a near-real-time CMR data feed. This may result in procedures that are shorter, safer, and less error-prone.

## Acknowledgements

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