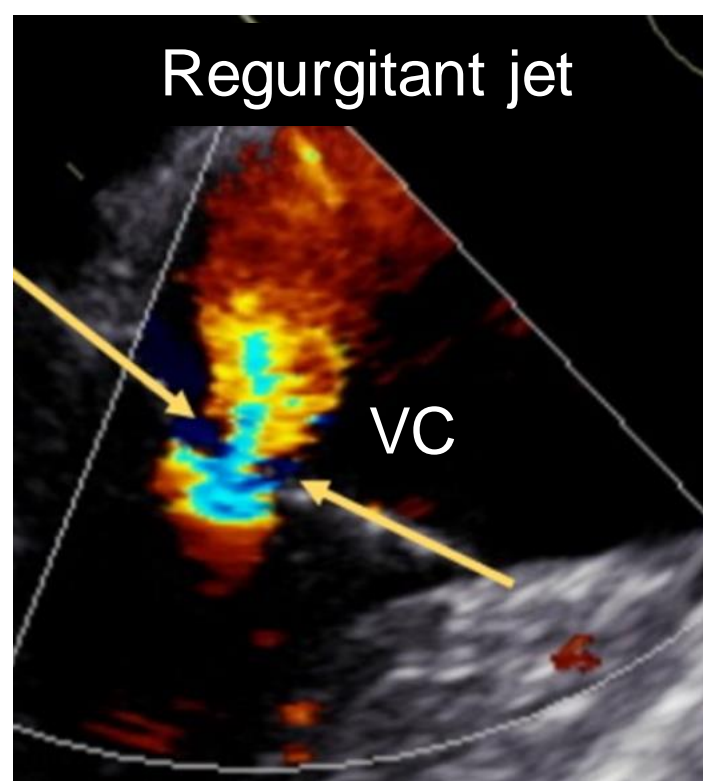


An IGS for Tricuspid Valve Interventions: 3D Localization of Vena Contracta using Doppler ICE Imaging

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INTRODUCTION

- Tricuspid regurgitation (TR) is the backwards flow of blood through the tricuspid valve (TV) into the right atrium, that can be seen on Doppler ultrasound imaging as a jet.
- Vena contracta (VC) or the neck of the regurgitant jet is an important landmark.
- Intraprocedural TV imaging is demanding due to its anatomical position.
- Simultaneous visualization of VC and tool tip in ultrasound is also challenging.
- Currently, TV interventions are in experimental phase and performed under TEE ultrasound and fluoroscopy which are suboptimal for visualizing TV anatomy. Therefore, Intracardiac echo (ICE) imaging is often recommended for TV procedures



OBJECTIVE

The need: Due to the TEE-unfriendly nature of the TV, it becomes challenging to identify the regurgitation site and then position the repair device correctly.

Proposed solution: A magnetically-tracked ICE probe is used in Doppler mode to identify the VC location in 3D space. This pre-mapped location, along with the annulus ring, will serve as important landmarks during device positioning. A clinician may use this information to position and orient the tracked-tools at the coaptation gap with minimal ultrasound imaging.

Study objective: Identify regurgitation site in 3D on a beating heart phantom with patient-specific TV.

METHODS

EXPERIMENTAL SET-UP

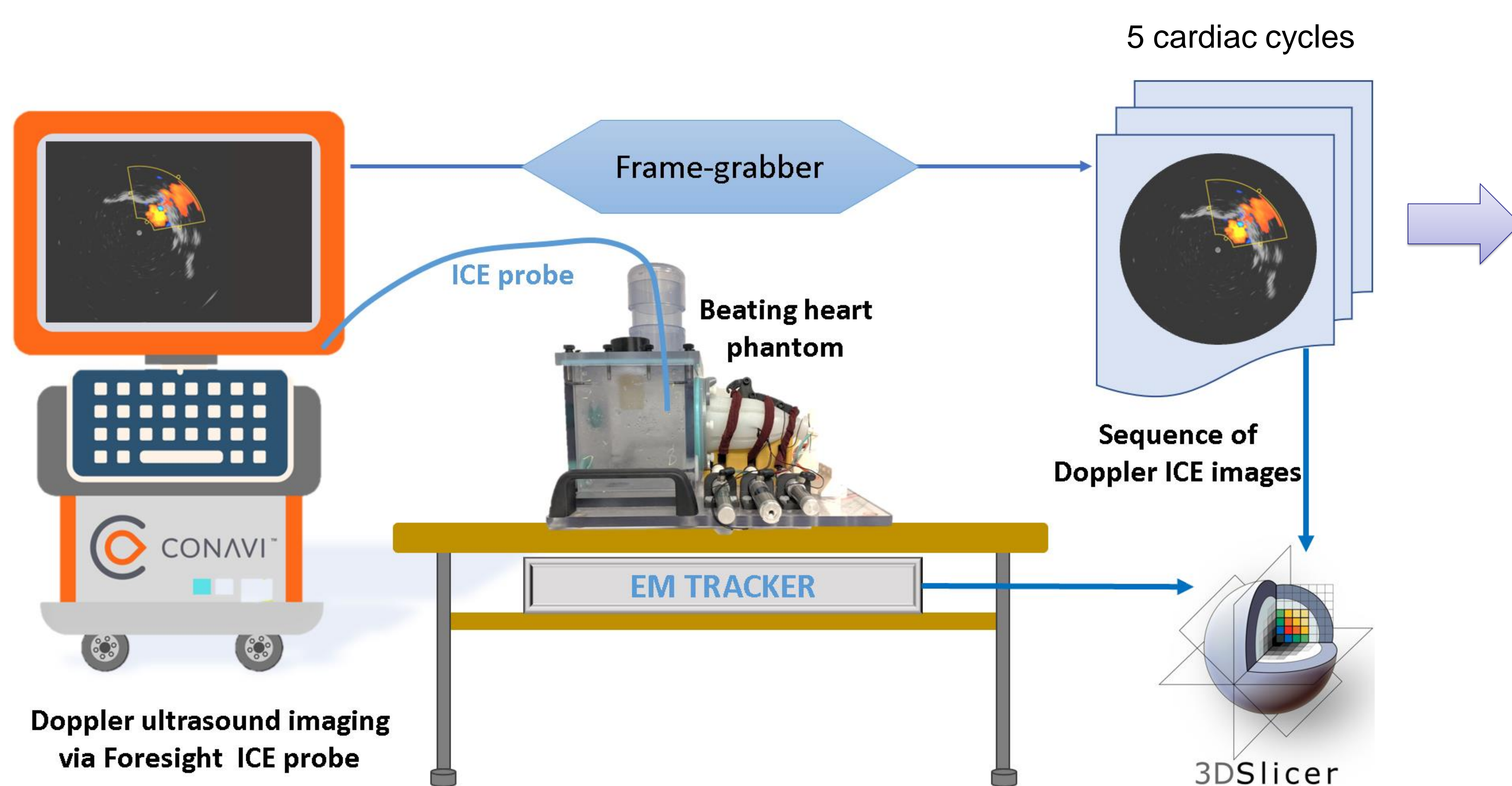
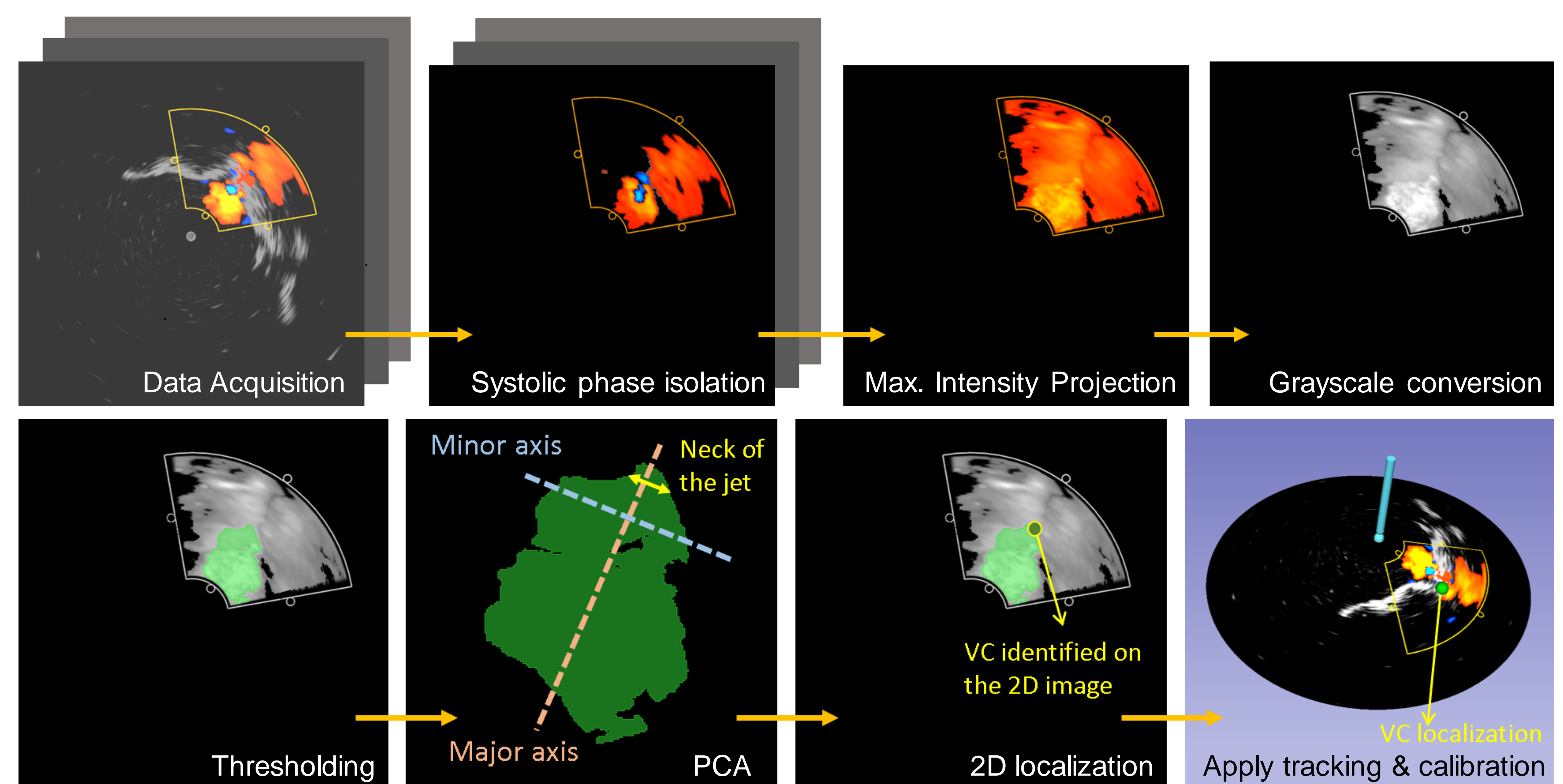


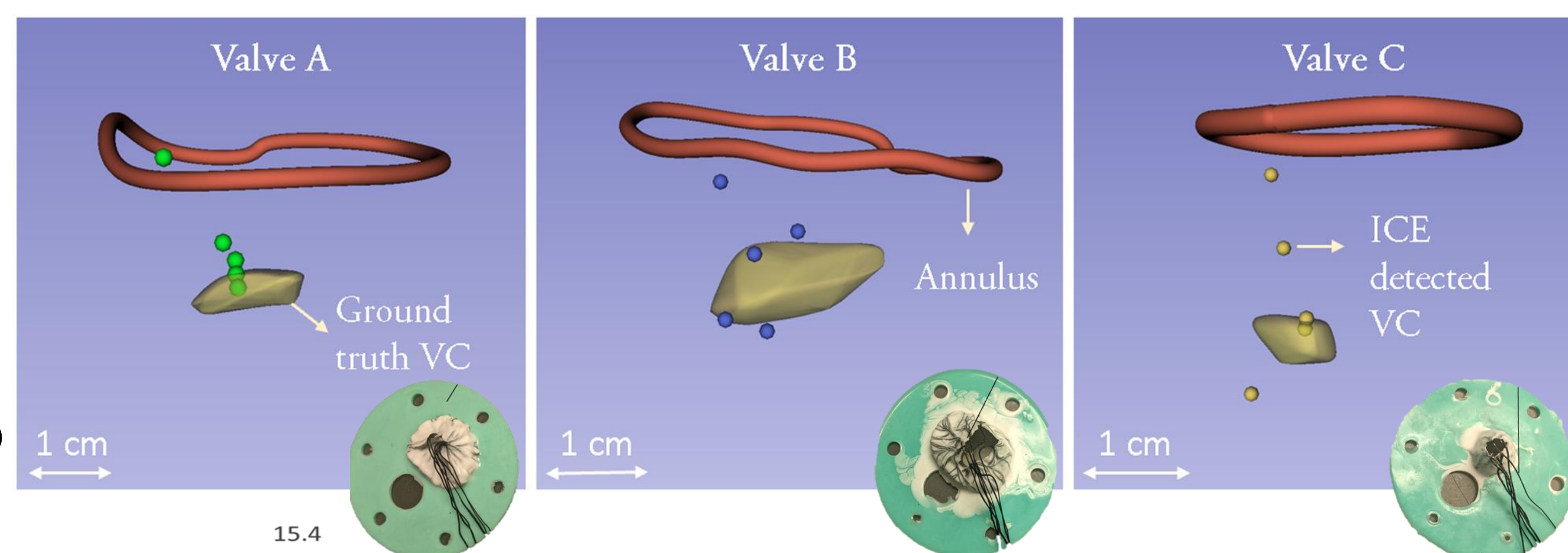
IMAGE PROCESSING



RESULTS

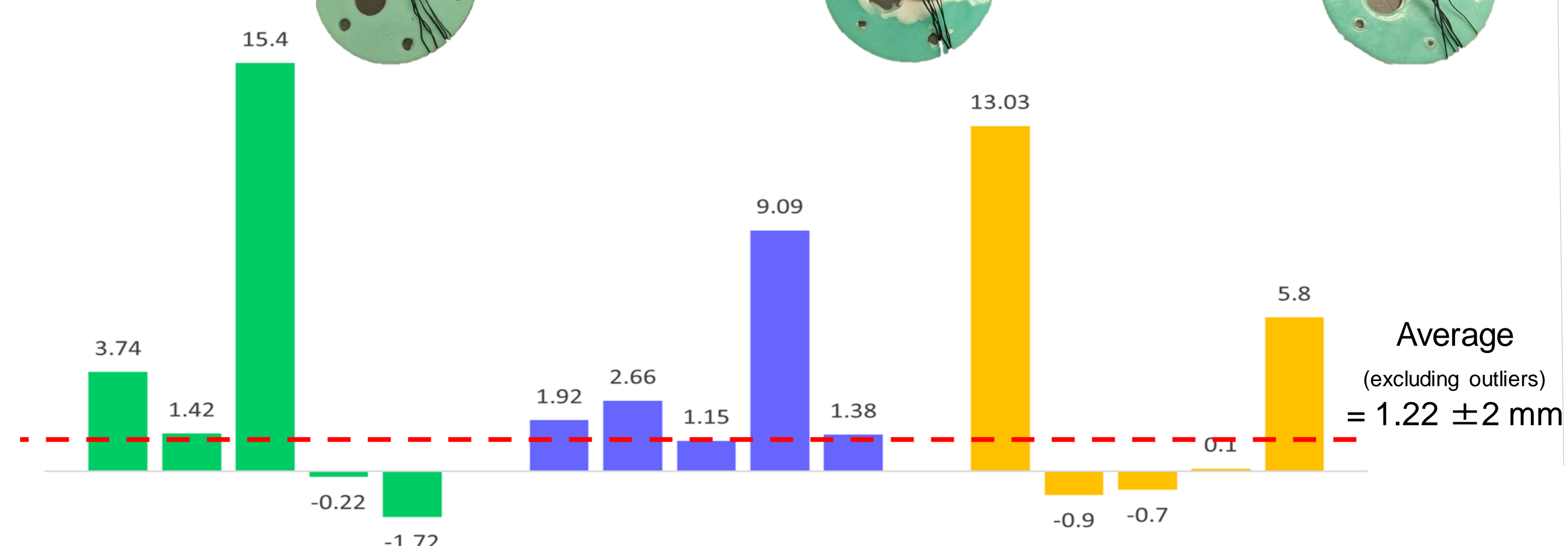
QUALITATIVE EVALUATION:

3D visualization of the algorithm-identified VC location (1 point per trial) in comparison to the manually-identified ground truth VC (in yellow). Manually identified TV annulus ring shown in red to provide more contextual information.



QUANTITATIVE EVALUATION:

Distance error (mm) Between the identified points & the ground truth surface



CONCLUSION

This study proposes a novel idea of an Image-guided system (IGS) that can potentially simplify the process of device positioning during TV repair by providing more contextual information i.e., by pre-mapping the location of coaptation gap or the regurgitation site.

In this study, a tracked ICE probe is used to localize the vena contracta (VC) of the regurgitant jet seen in Doppler ICE imaging with adequate accuracy.

LIMITATIONS

- Ground truth \neq gold standard, since it is manually acquired in a dynamic (beating heart phantom) setting.
- Outliers are present due to the low-frame rate on the frame-grabber, resulting in insufficient Doppler imaging of the regurgitant jet \rightarrow Can be overcome by using a frame rate of at least 30 fps.

FUTURE WORK

- Evaluate efficiency on a wider range of TV pathologies as well as in-vivo testing of the algorithm.
- User study to evaluate the clinical feasibility of the system in terms of spatial awareness.