XFM – transition to iCMR

Amish N. Raval MD
Associate Professor of Medicine
And Biomedical Engineering
U. Wisconsin School of Medicine and Public Health
anr@medicine.wisc.edu

No conflicts to disclose  
SCMR Los Angeles  Jan 28, 2016
Structural Heart Interventions

- XRF
- US
- EM nav
- CT
- MRI

IMAGE CO-REGISTRATION

- Improve success & safety
- Improve efficiency
- More minimally invasive options
- Transition to iCMRI
XFM: Surface Fiducials

Application: Endomyocardial Tumor Biopsy

Gutierrez, de Silva, Raval, Lederman 2007 CCI
XFM: Surface Fiducials

- MRI immediately prior to XRF
- Fiducial markers may interfere with intra-op imaging
- Skin and organs are not rigidly fixed

Gutierrez, de Silva, Raval, Lederman 2007 CCI
XFM: Internal “Marker” Alignment

“Syngo InSpace 3D/3D fusion, iPilot dynamic, register to patient”

Hazeem, Dori 2011 Circ Cardiovasc Imaging
XFM: “Anatomy of Interest” Alignment

Transendocardial Injection

Targeting Error 0.9 +/- 5.0 mm

Tomkowiak, Raval 2011 CCI

Klein, Raval 2012 CCI

Schmuck, Raval 2015 JCardTransRes
Why isn’t XFM routinely adopted?

Mis-registration

Lack of RT 3D Device Tracking

Workflow Inefficiencies

Lack of Infrastructure $$$
MRI to EM to 3DUS to XRF
Motion Compensation

Application: Transendocardial Stem Cell Delivery

Hatt, Jain, Pathasarathy, Raval. 2013 Comp Med Imag Graph
RT 3D Tracking of Devices for TAVR – biplane XRF

Hatt CR, Raval AN. Efficient Feature-based 2D/3D Registration of TEE to XRF for Cardiac Interventions. SPIE 2014

Hatt CR, Raval AN. Robust 5DOF trans-esophageal echo probe tracking at 50 fps. MICCAI 2015


Hatt CR, Raval AN, Spiedel M. Dynamic tracking of prosthetic valve motion and deformation from bi-plane x-ray views: feasibility study - 2016 in press
Low Dose, Single XRF Gantry, rt3D Device Tracking

Scanning Beam Digital X-ray (SBDX)

510K Approved, Novaray & Triple Ring Technologies
3D US to XRF using Single Gantry, low Dose SBDX

Hatt, Raval, Speidel 2015 Med Phys
Interventional Image Co-Registration – Zeroing in . . .

- **Surface Fiducials**
- **Internal Markers**
- **Anatomy Of Interest**

**Motion Compensation**
- Patient Motion
- Cardiac Motion
- Respiratory Motion
- Device-related Distortion

**rt Device Tracking**
- Biplane XRF
- EM based SBDX
Thank you for your attention!

Madison, WI