Three-dimensional image registration

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Three-dimensional image registration

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- Transform

- Diagram

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- Future work

- Reference

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Introduction

What is Registration?

- The process of finding the transformation that constitutes the best alignment between images. Ex. Images acquired of the same patient at different times (head position).

Why do registration?

- The need occurs when the images have to be process, and the algorithm assumes that the images are aligned. Ex. Merge images.

Registration Methods

i. Manual methods

   - User does all the alignment and the computer provides only the visual feedback

ii. External Landmark Registration

   - Oil markers are placed on patient before image acquisition.

   - Two steps: 1. Identify at least three pairs of corresponding points; 2. Calculate the transformation using the corresponding points;
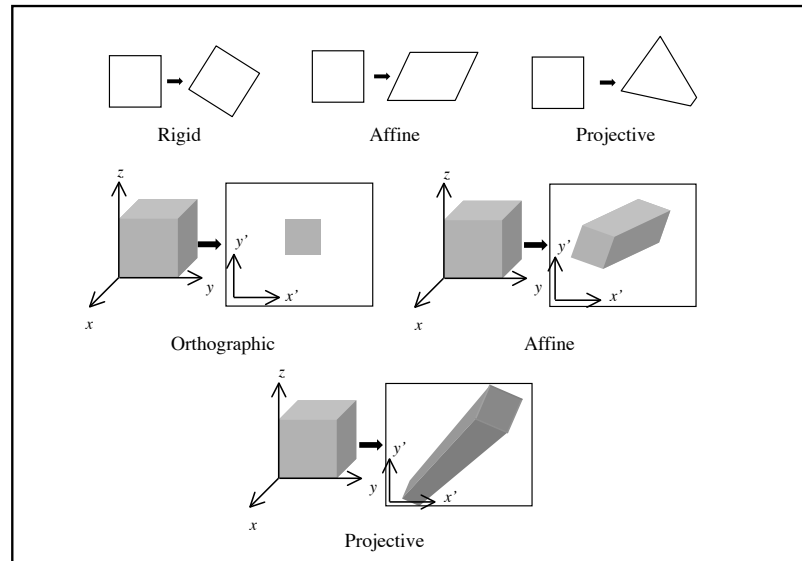
Registration Methods

iii. Voxel intensity-based

- Metric - Ex. Normalized Mutual Information;

- Optimization method - Ex. Extensive direction - Ramp;

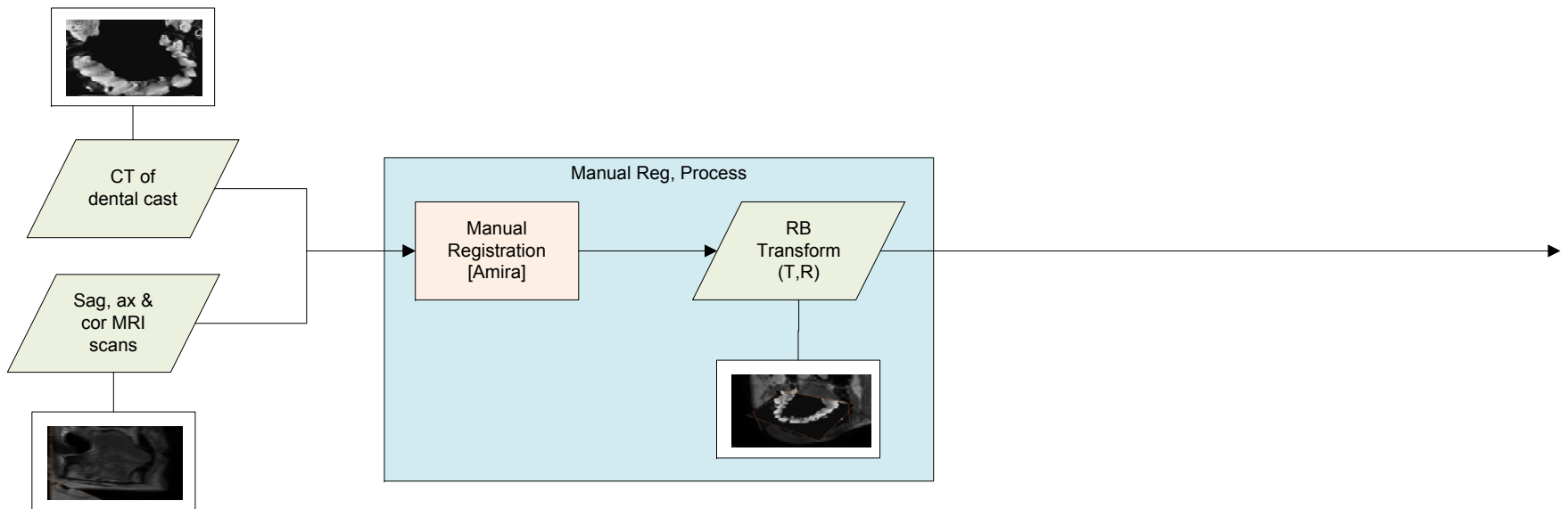- Transformation model - Ex. Rigid-body transform;

Data	Data	Reg.	obs
MRI	CT	M/EL	-
MRI	MR	M/EL/VI	-

Transform

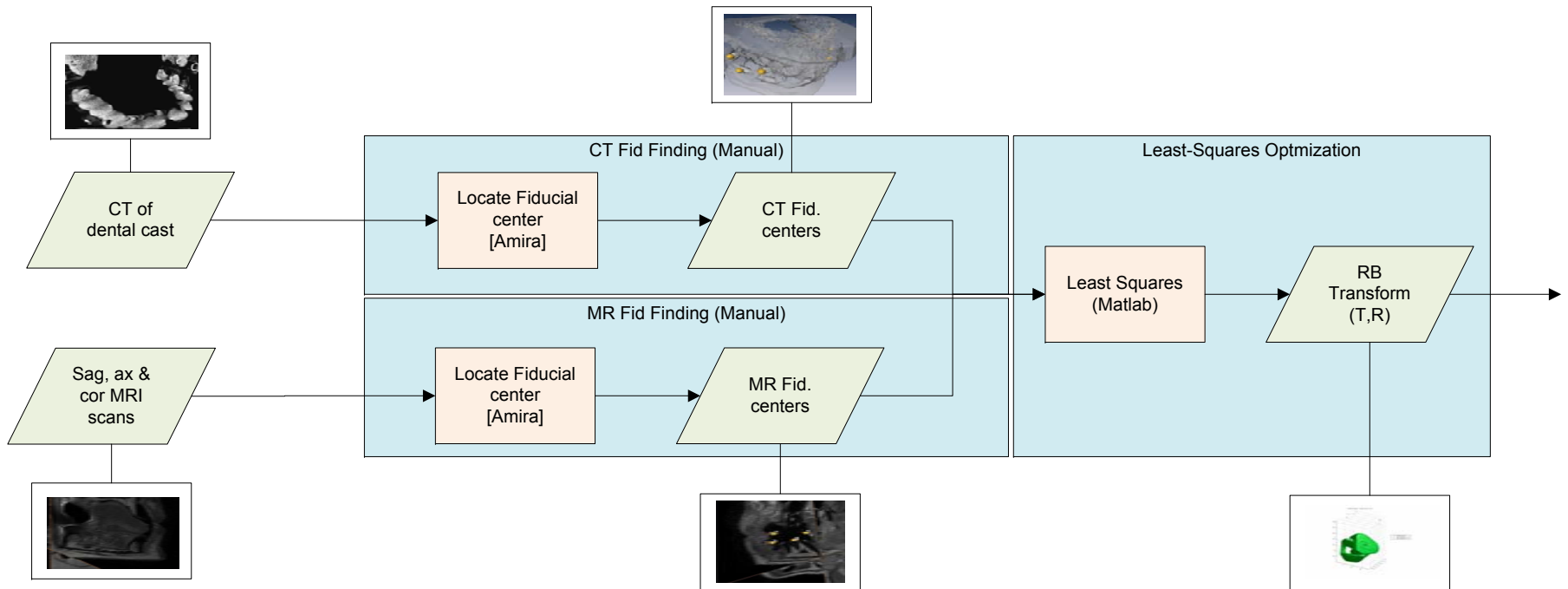|	Reflection	Translation	Rotation	Scaling	Projection	Curves
Rigid	X	X	X			
Affine	X	X	X	X		
Projective	X	X	X	X	X	
Curved	X	X	X	X	X	X

Registration Methods - Diagram
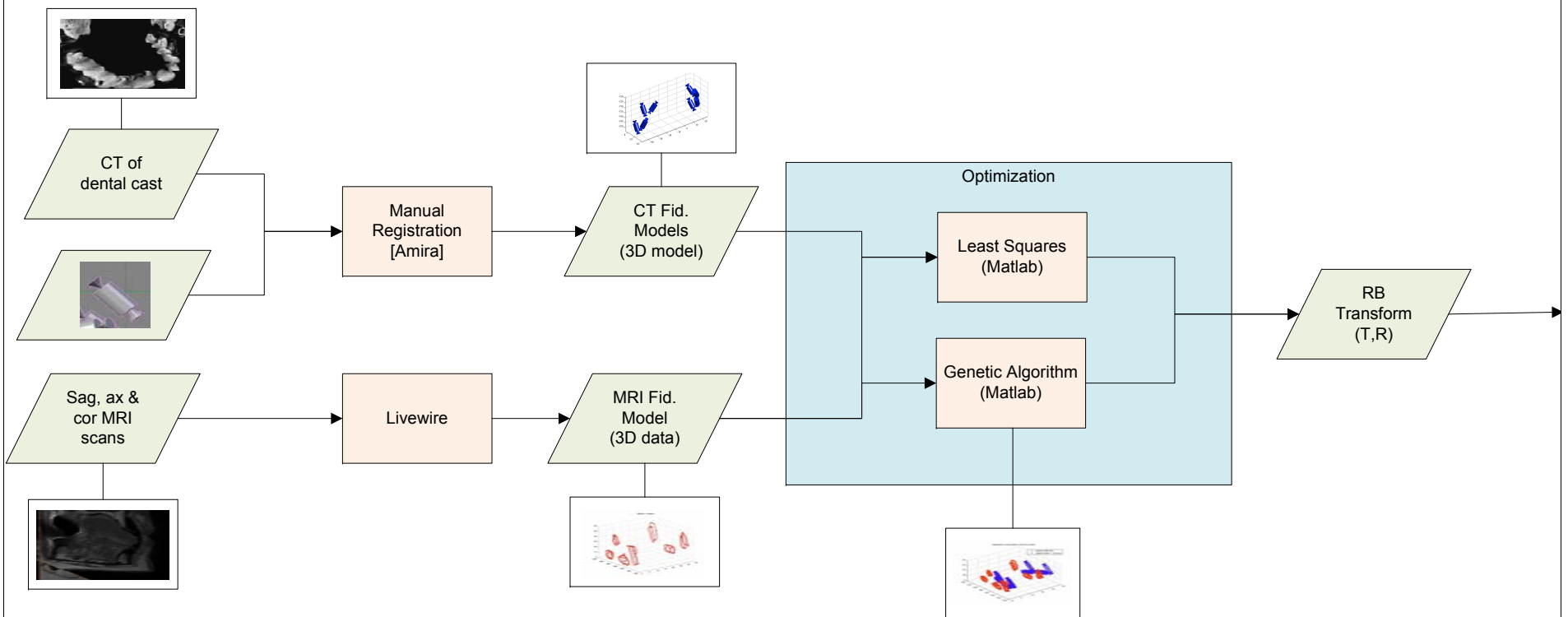
i. Manual methods

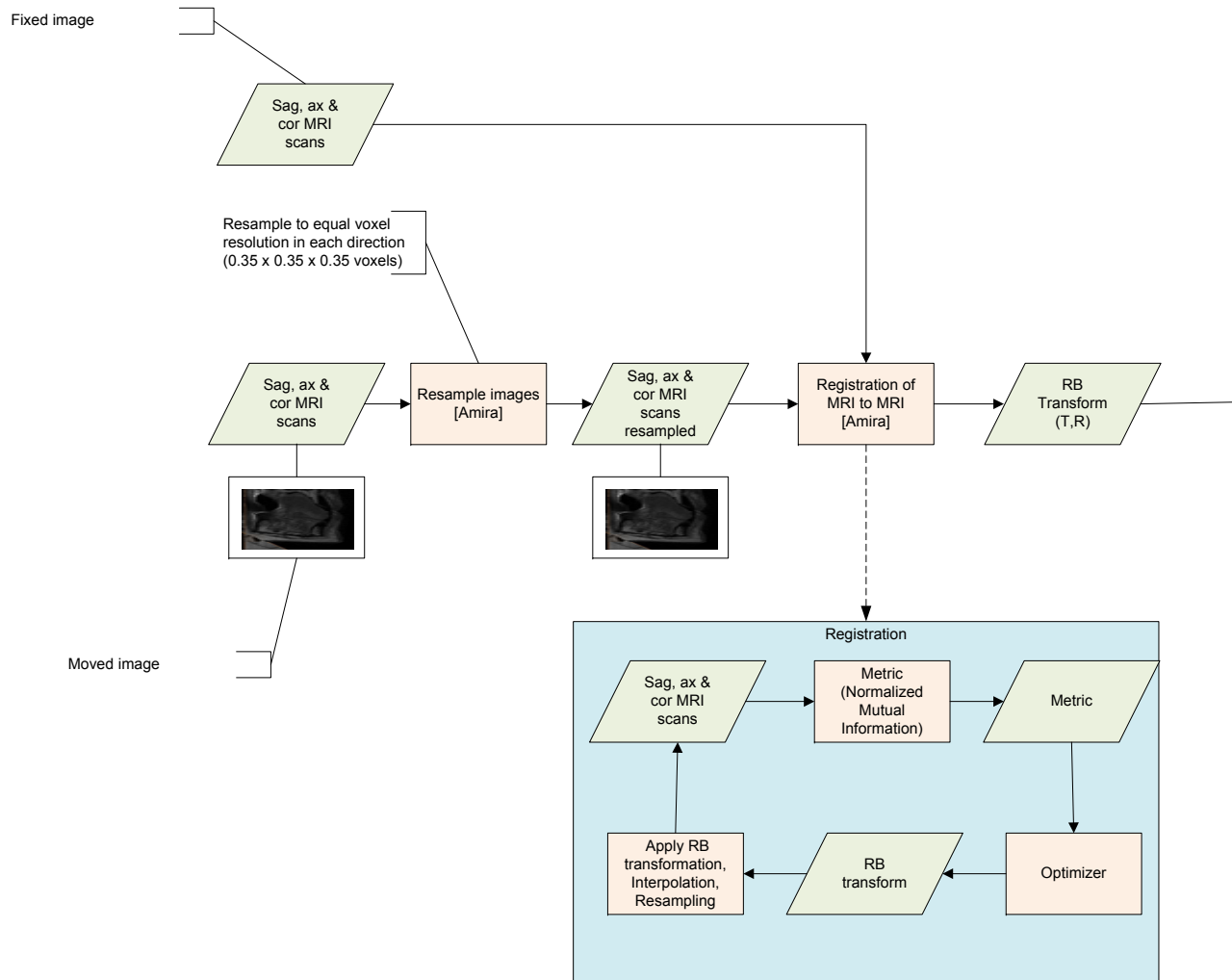# Registration Methods - Diagram

ii. External Landmark Registration
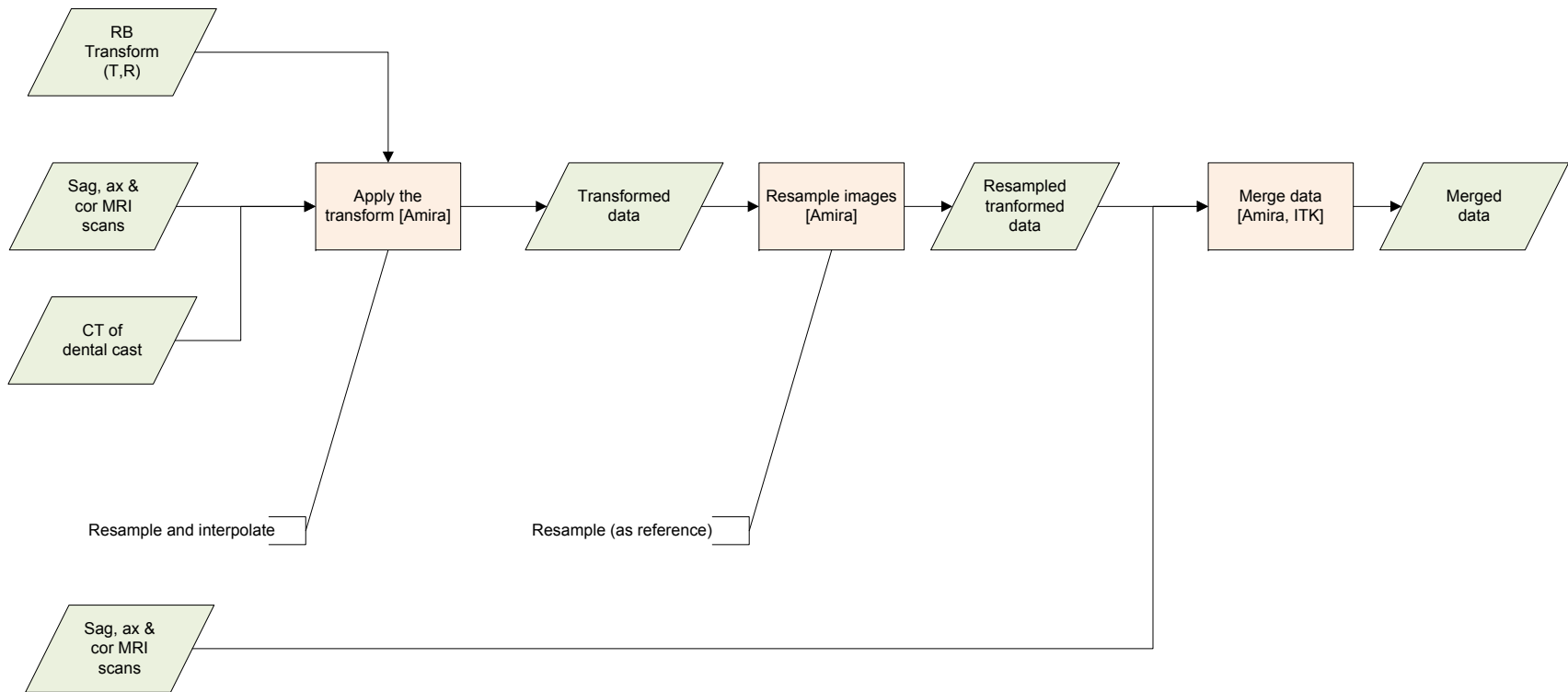
Registration Methods - Diagram

Registration Methods - Diagram

iii. Voxel intensity-based

Fixed image

Sag, ax & cor MRI scans

Resample to equal voxel resolution in each direction (0.35 x 0.35 x 0.35 voxels)

Sag, ax & cor MRI scans → Resample images [Amira] → Sag, ax & cor MRI scans resampled → Registration of MRI to MRI [Amira] → RB Transform (T,R)

Moved image

Registration

Sag, ax & cor MRI scans → Metric (Normalized Mutual Information) → Metric

Apply RB transformation, Interpolation, Resampling ← RB transform ← Optimizer
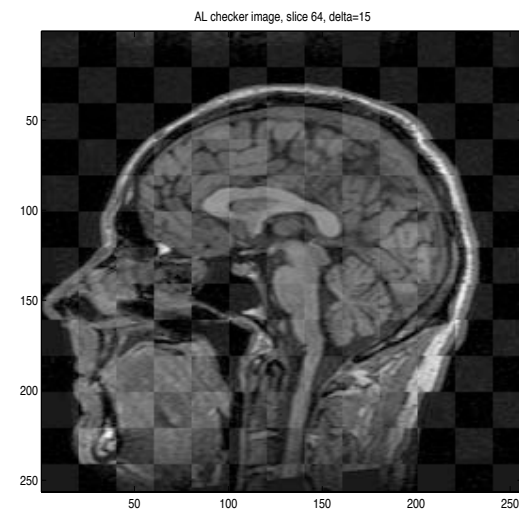
Merge data - Diagram

Result

CT and MR merged Data

MR merged Data

Future Work

- Implement Template Matching to detect the markers in MR and CT scans

- Implement the Checkerboard to visual validation (MR registration)

AL checker image, slice 64, delta=15

Questions

Questions?

Comments?

References

[1] Bedell, Barry J. and Narayana, Ponnada A. and Johnston, Dennis A. *Three-Dimensional MR Image Registration of Human Brain.* Magnetic Resonance in Medicine, 384-390

[2] Black, Kevin John and Videen, Tom O. and Perlmutter, Joe S. *A metric for Testing the Accuracy of Cross-Modality Image Registration: Validation and Application.* Journal of Computer Assisted Tomography, 855 861, 1996.

[3] Shinji Umeyama. "Least-Squares Estimation of Transformation Parameters Between Two Point Patterns." IEEE Transactions on Pattern Analysis and Machine Intelligence. Vol 13, No. 4, April 1991."

References

[4] Kaneko et al., 2003. "Robust matching of 3D contours using iterative closest point algorithm improved by M-estimation". Journal of the Pattern Recognition Society. v36. 2041-2047.

[5] Chetverikov et al., 2005. "Robust Euclidean alignment of 3D point sets: the trimmed iterative closest point algorithm". Image and Vision Computing. v23. 299-309.