

Medical Image Registration Report

Rigid + Affine Registration (6+9 DOF)

Registration Pipeline Summary:

- Stage Limit: AFFINE
- Coordinate System: Common world coordinates
- Resolution Preservation: Original image resolutions maintained
- Bidirectional Results: Both source→target and target→source

Registration Stages:

- Rigid (6 DOF): Translation + Rotation
- Affine (9 DOF): + Scaling (no shearing)
- SVFFD: + Non-linear deformation

Visualization Features:

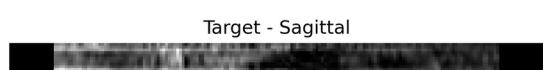
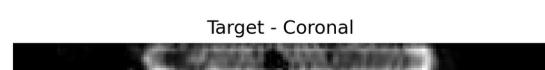
- Side-by-side anatomical comparisons
- Convergence analysis with loss curves
- Flow field and vector analysis
- Grid deformation with movement arrows
- Multi-view anatomical overlays (sagittal, axial, coronal)

Generated ~~Report generated for sequential medical image registration~~

Implementation: Clean modular architecture with comprehensive debugging

Initial Alignment - Before Registration

Common Coordinate Space Comparison - initial_alignment

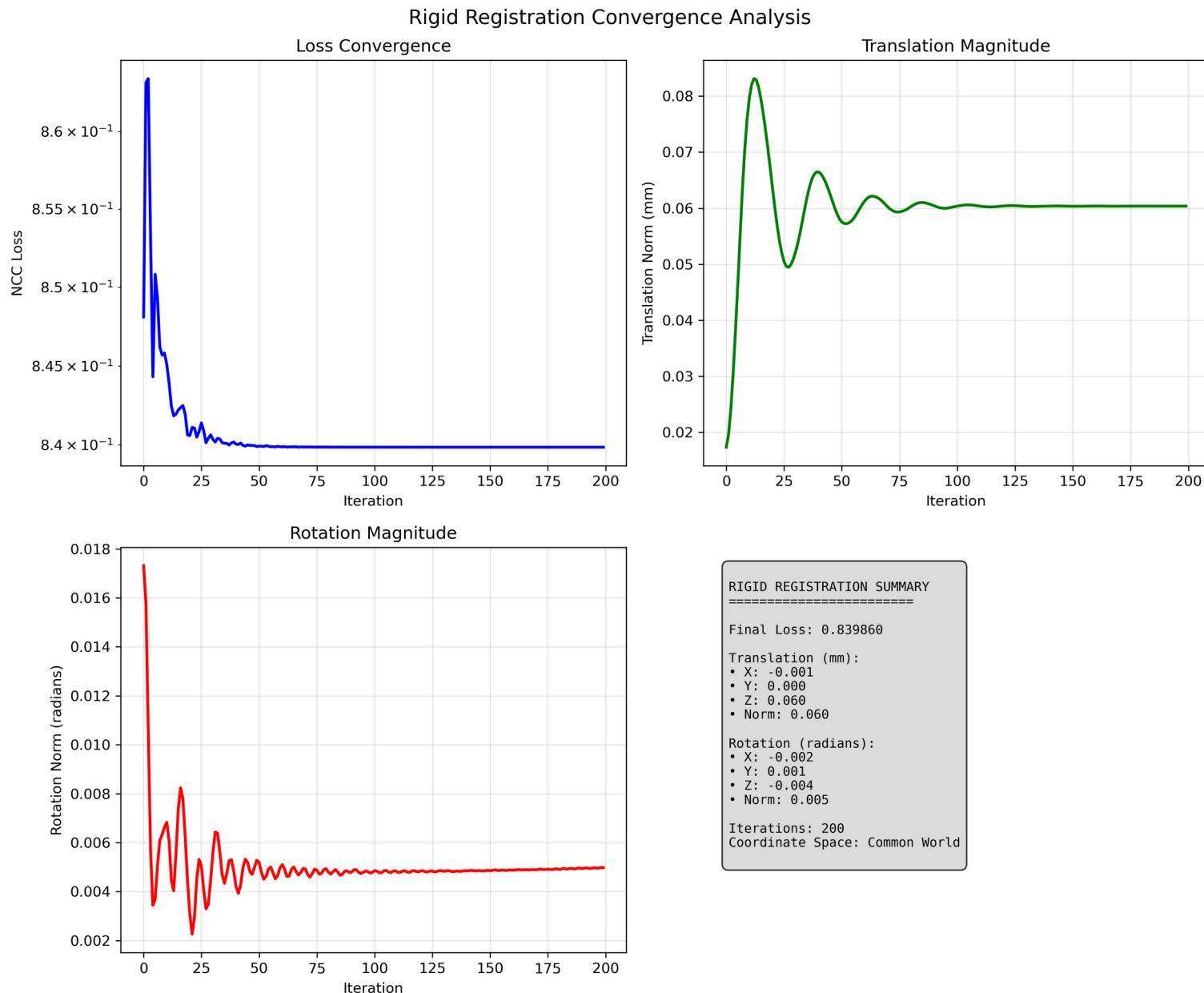


Rigid Registration Result

Common Coordinate Space Comparison - rigid_result

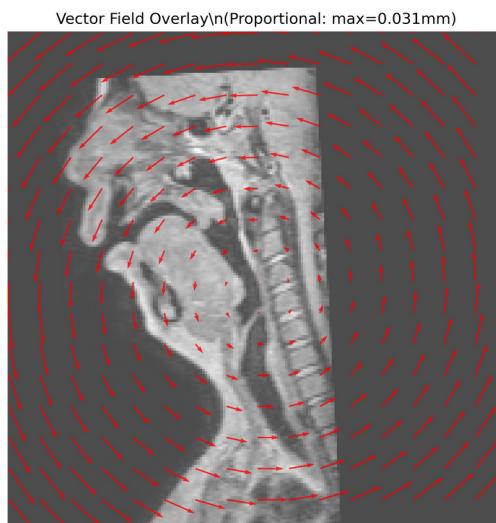
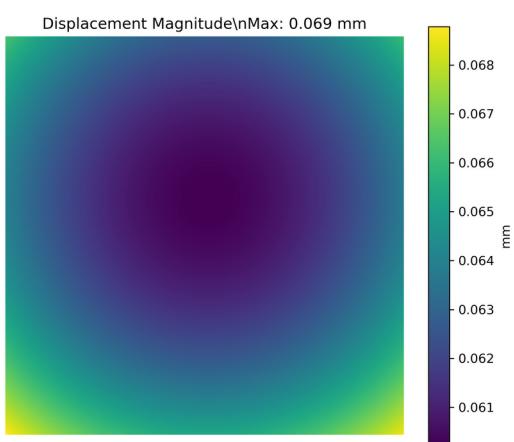
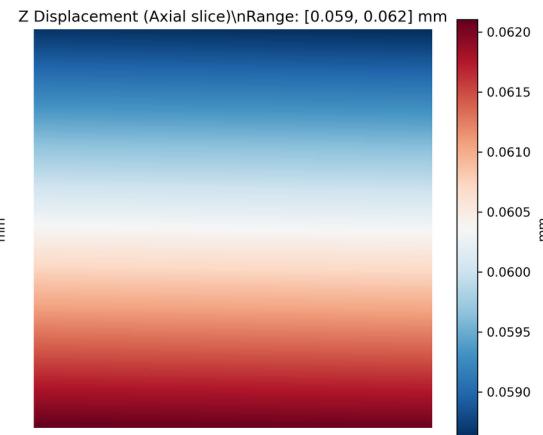
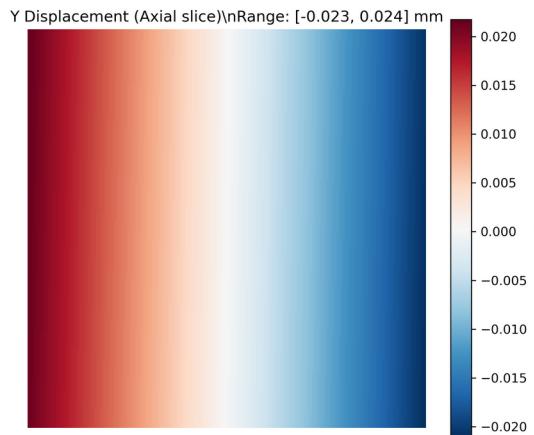
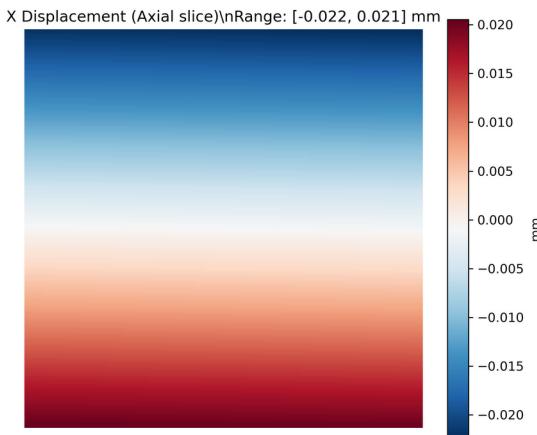


Rigid Registration Convergence Analysis



Rigid Flow Field and Vector Analysis

Rigid Transformation Flow Field Analysis



RIGID TRANSFORMATION ANALYSIS

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Translation Vector (mm):

- X: -0.000897
- Y: 0.000467
- Z: 0.060361
- Magnitude: 0.060369

Rotation Vector (radians):

- X: -0.002458
- Y: 0.000547
- Z: -0.004292
- Magnitude: 0.004976

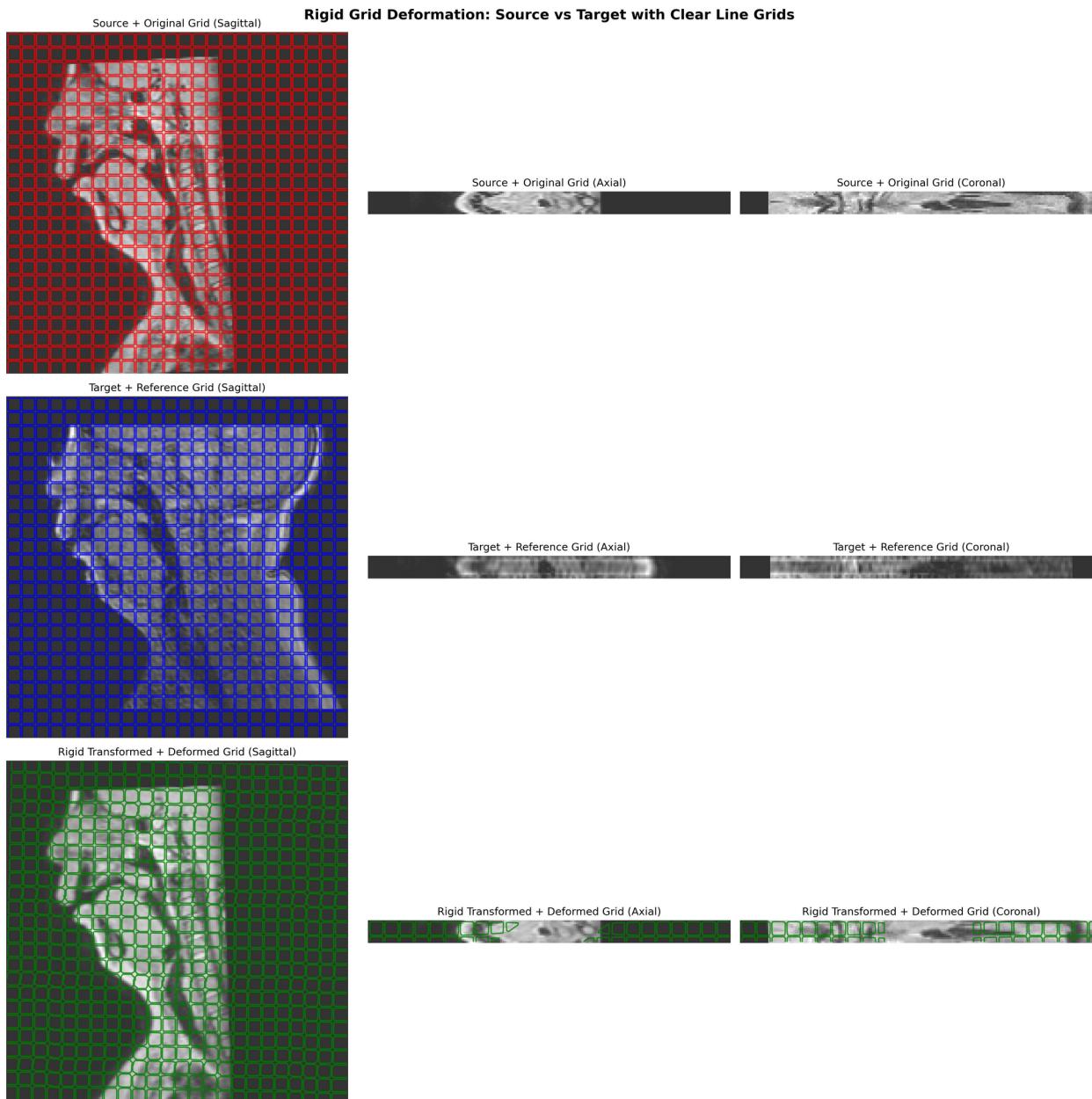
Displacement Field Statistics:

- Max displacement: 0.069 mm
- Mean displacement: 0.063 mm
- Std displacement: 0.002 mm

Grid Deformation Properties:

- Type: Rigid body motion
- Preserves: Distances, angles, shapes
- DOF: 6 (3 translation + 3 rotation)
- Topology: Preserved (no folding)

Rigid Grid Deformation Visualization

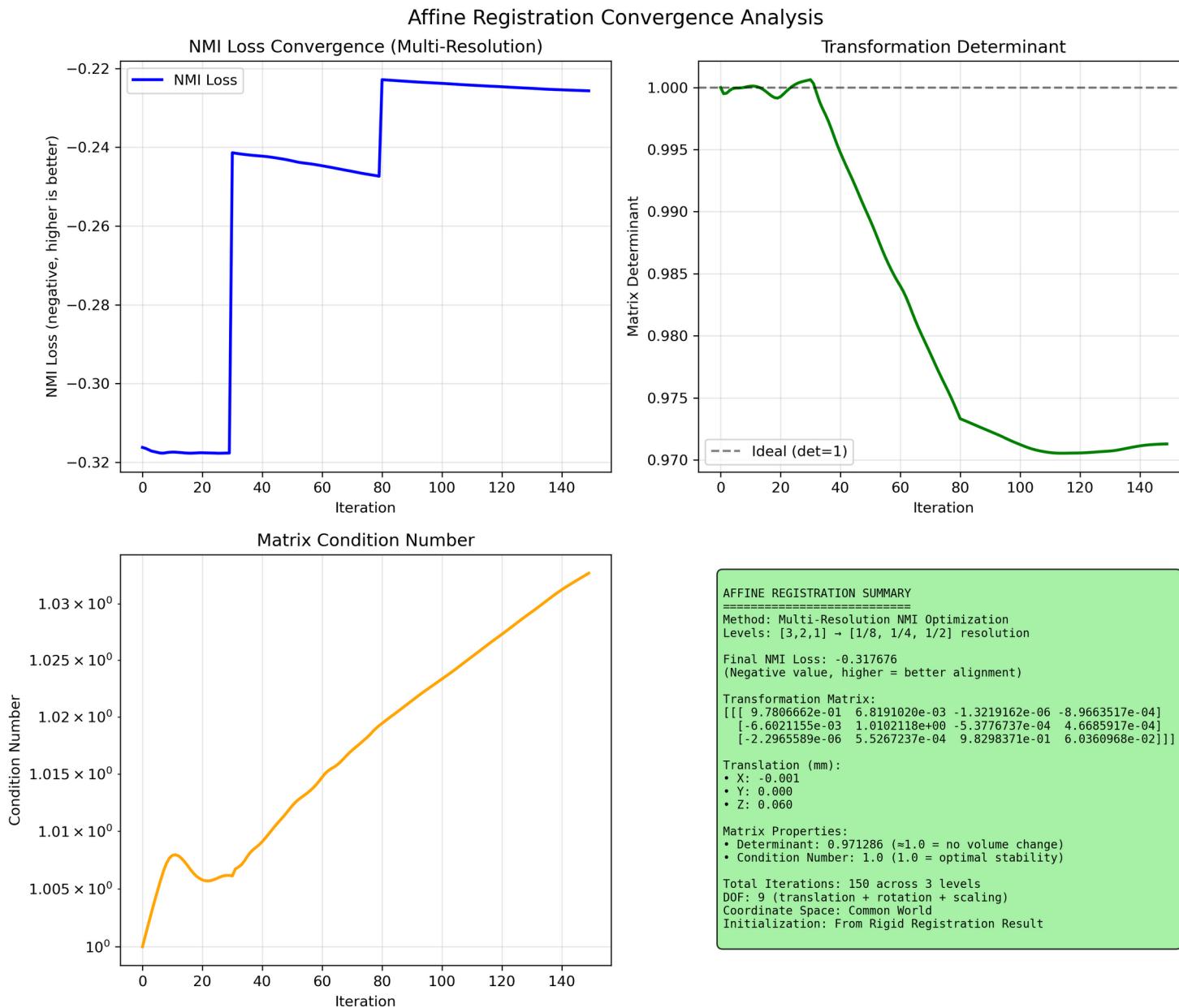


Affine Registration Result

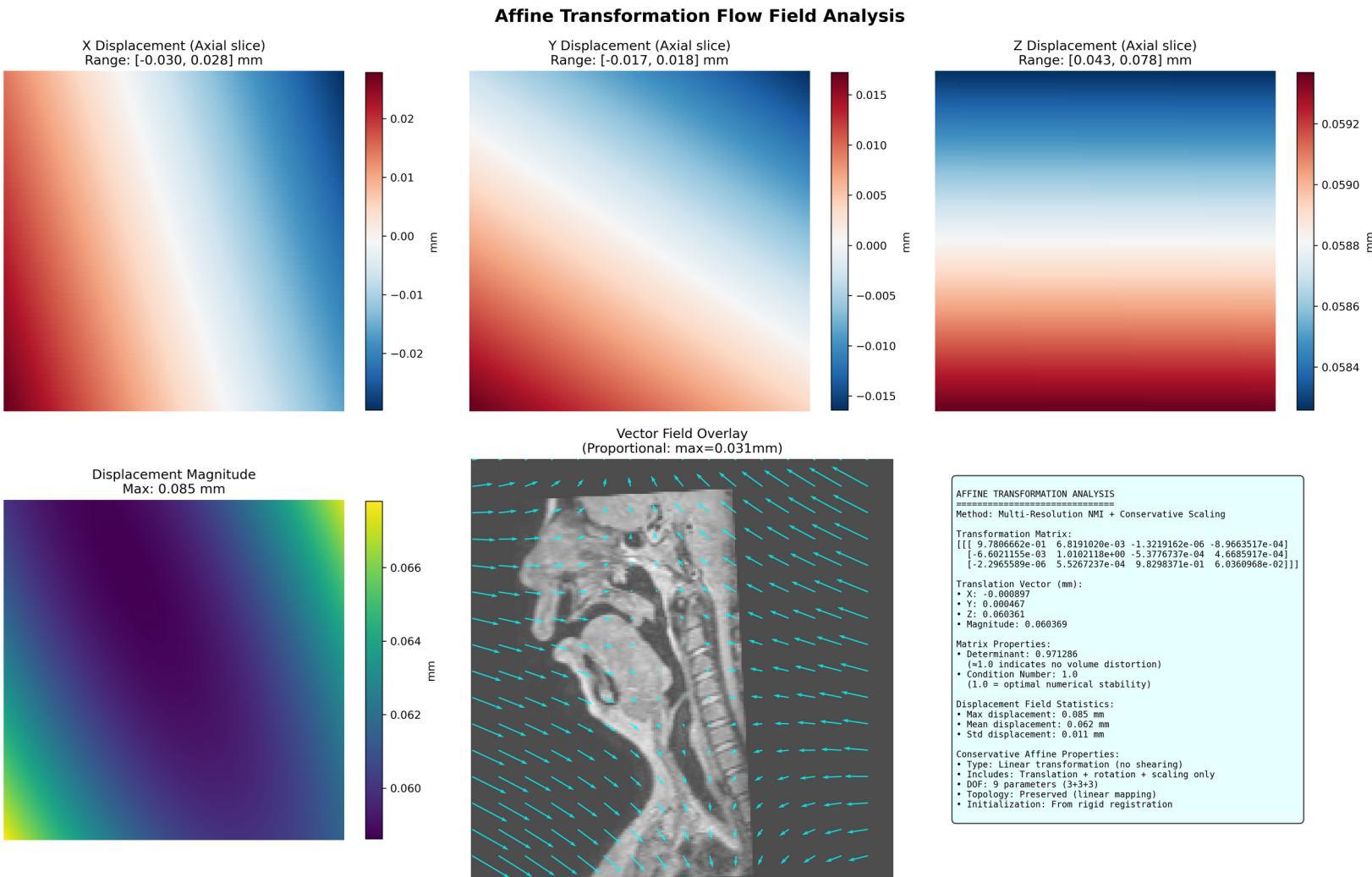
Common Coordinate Space Comparison - affine_result



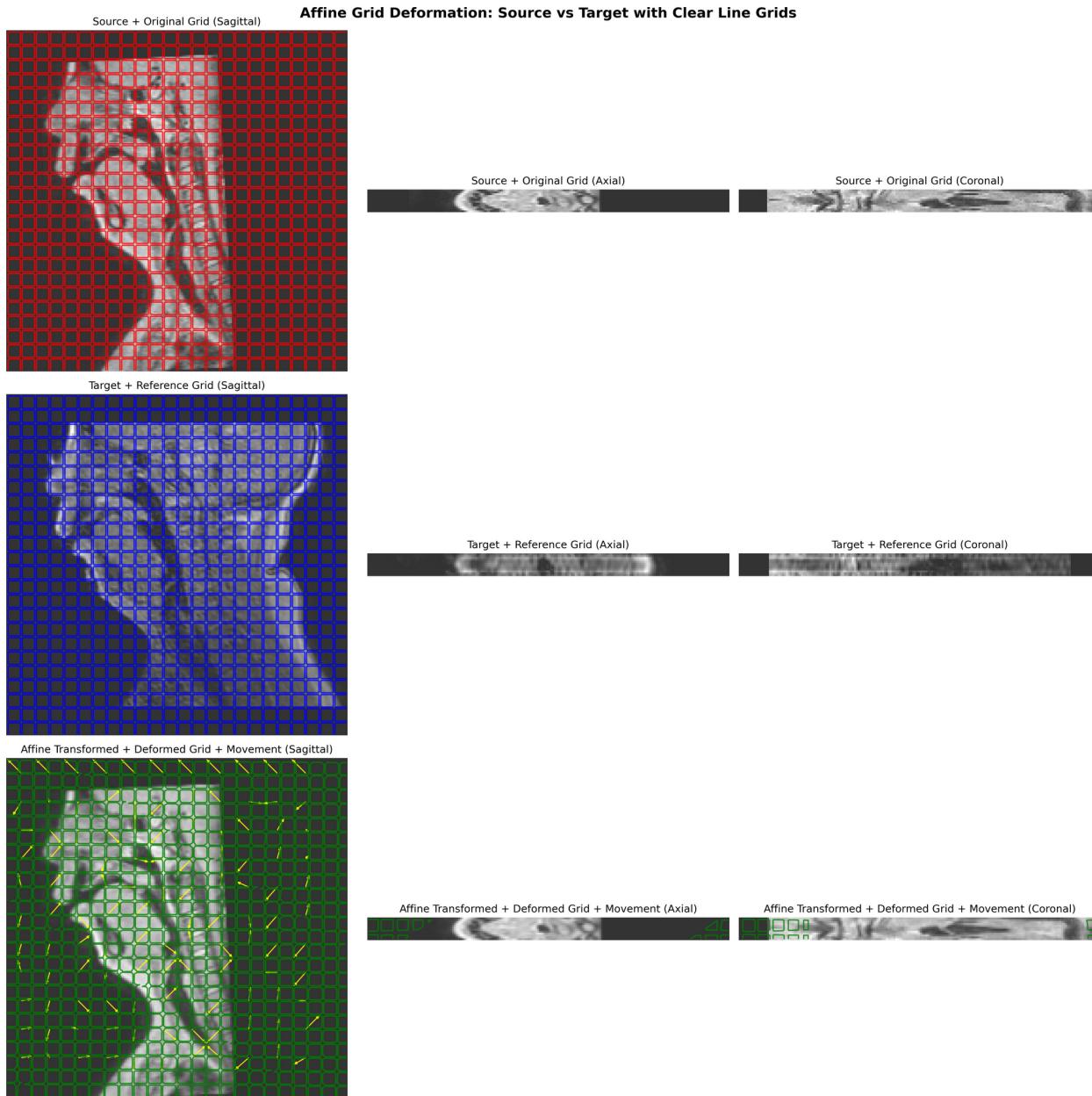
Affine Registration Convergence Analysis



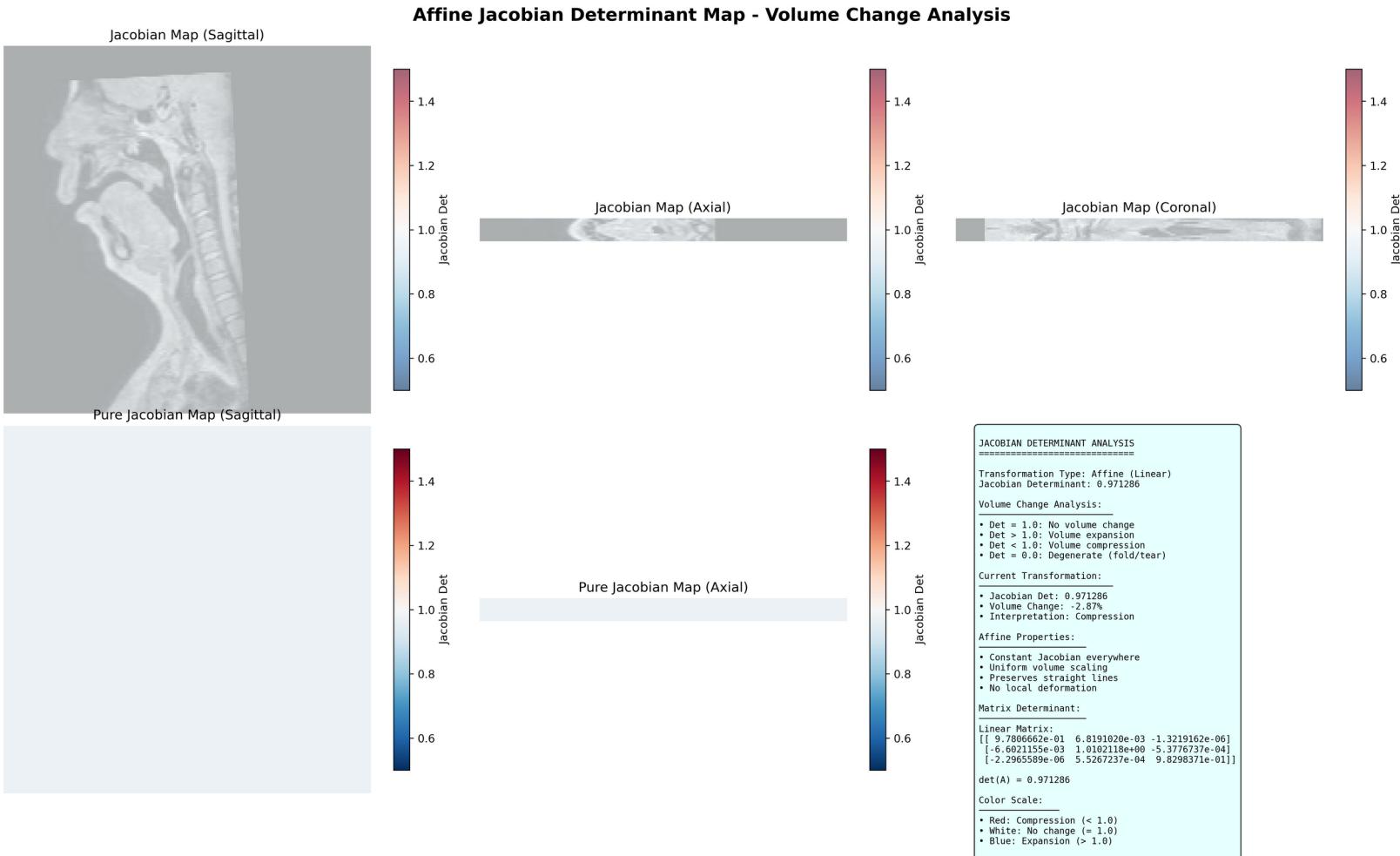
Affine Flow Field and Vector Analysis



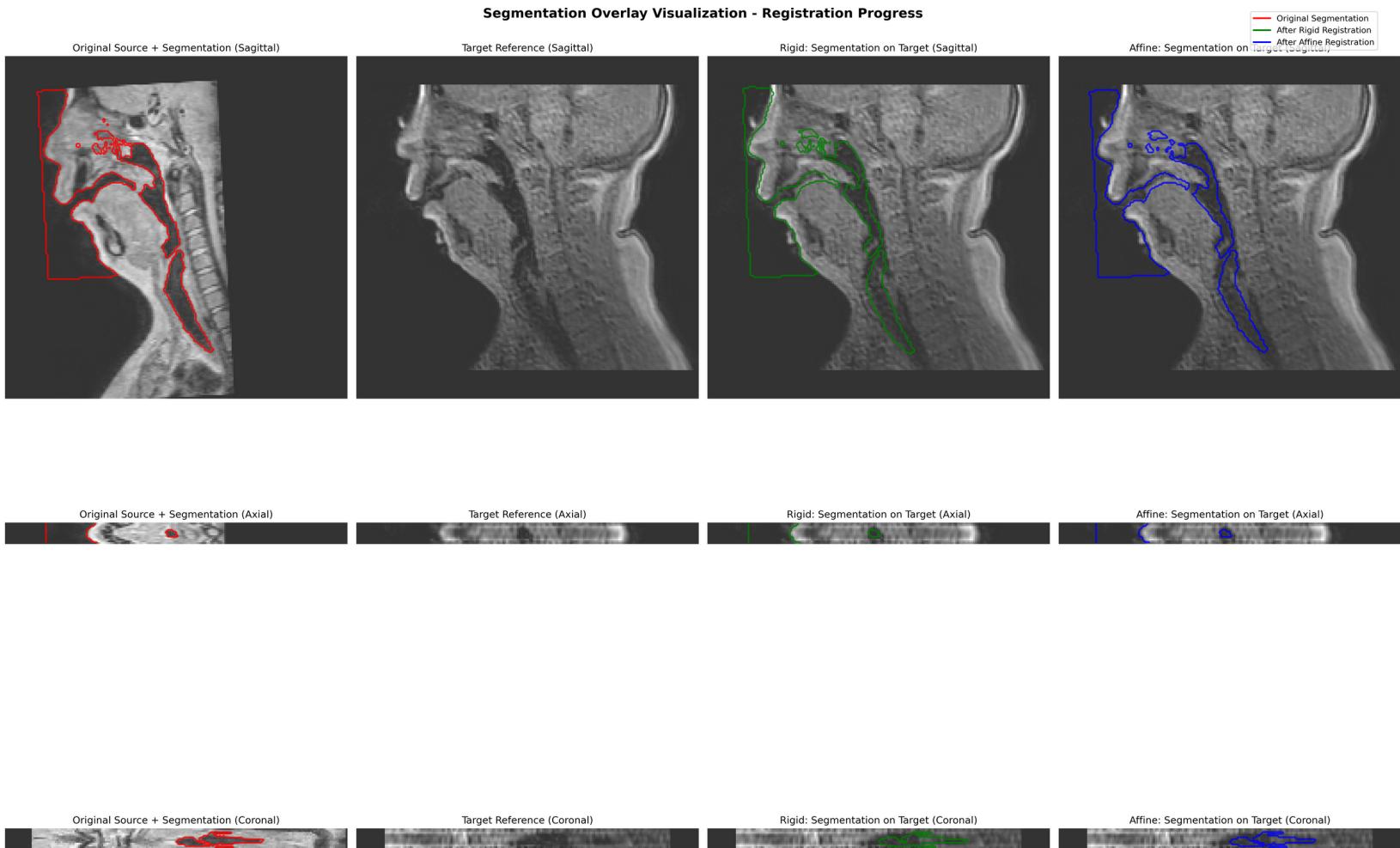
Affine Grid Deformation with Movement Arrows



Affine Jacobian Determinant Map - Volume Change Analysis



Segmentation Transformation Progress



Registration Summary

Registration Results Summary:

Stage Completed: AFFINE

Output Files Generated:

☐ Transforms:

- rigid_transform.pth
- affine_transform.pth (if applicable)
- svffd_transform.pth (if applicable)

☐ Final Results:

- source_moved_to_target_*.nii.gz
- target_moved_to_source_*.nii.gz
- source_reference.nii.gz
- target_reference.nii.gz

☐ Intermediate Results:

- source_after_rigid_common.nii.gz
- source_after_affine_common.nii.gz (if applicable)
- source_after_svffd_common.nii.gz (if applicable)

☐ Debug Analysis:

- Convergence analysis plots
- Flow field visualizations
- Grid deformation animations
- Side-by-side comparisons
- Vector movement arrows

Quality Metrics:

- All registrations performed in common world coordinates
- Mutual field-of-view masking applied for robust alignment
- Multi-resolution pyramid optimization used
- Original image resolutions preserved in final outputs

Verification:

Results can be verified in ITK-SNAP:

1. Load target_reference.nii.gz as main image
2. Overlay source_moved_to_target_*.nii.gz for alignment check
3. Compare with initial unregistered source for improvement assessment

Technical Implementation:

- Library: deepali medical image registration
- Loss Functions: NCC (rigid), NMI (affine), Bending energy (SVFFD)
- Coordinate System: Common world coordinates with proper spacing
- Interpolation: Linear (images), Nearest neighbor (segmentations)
- Transform Chaining: Rigid → Affine → SVFFD sequential optimization