

A tool for intraoperative visualization of registration results

Franklin King, Andras Lasso, Csaba Pinter, and Gabor Fichtinger

Laboratory for Percutaneous Surgery, School of Computing, Queen's University,
Kingston, Canada

Introduction

Background

Validation of image registration algorithms is frequently accomplished by the visual inspection of the resulting transformation. The quick visualization of transformations produced by image registration algorithms during image-guided interventions would allow for a clinician to rapidly evaluate the accuracy of the result transformation.

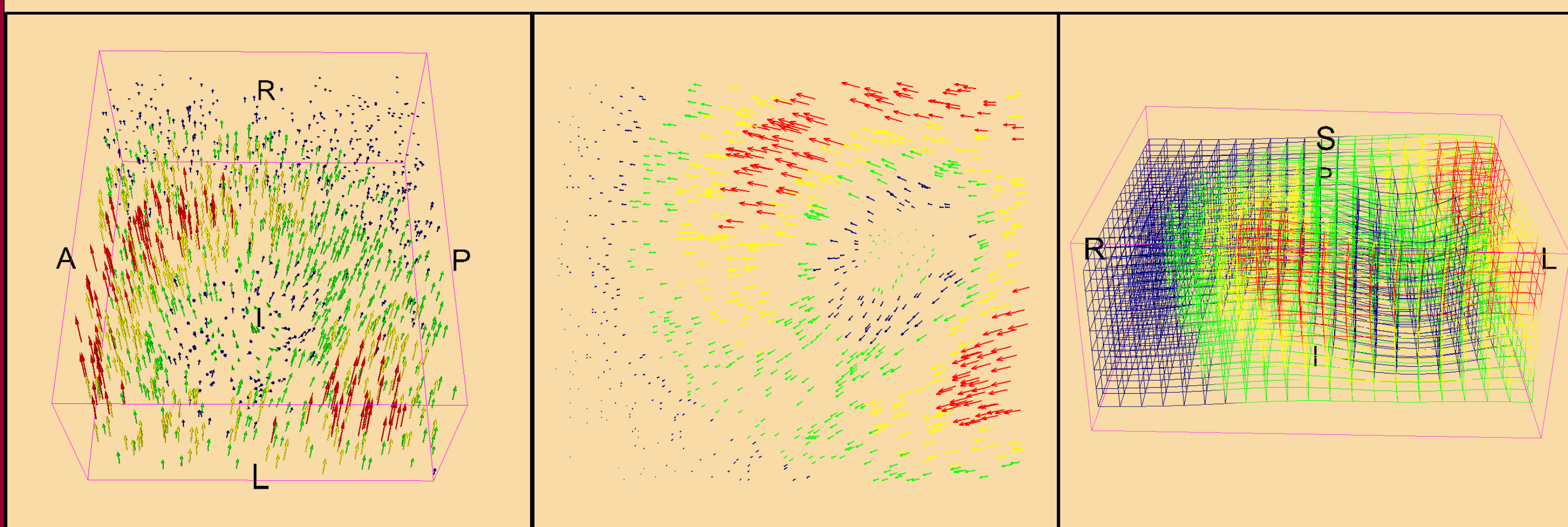
Objective

To create a tool that visualizes both linear and deformable transformations and is integrated in an open-source software application framework suited for intraoperative use and general evaluation of registration algorithms.

Methods

Visualizations

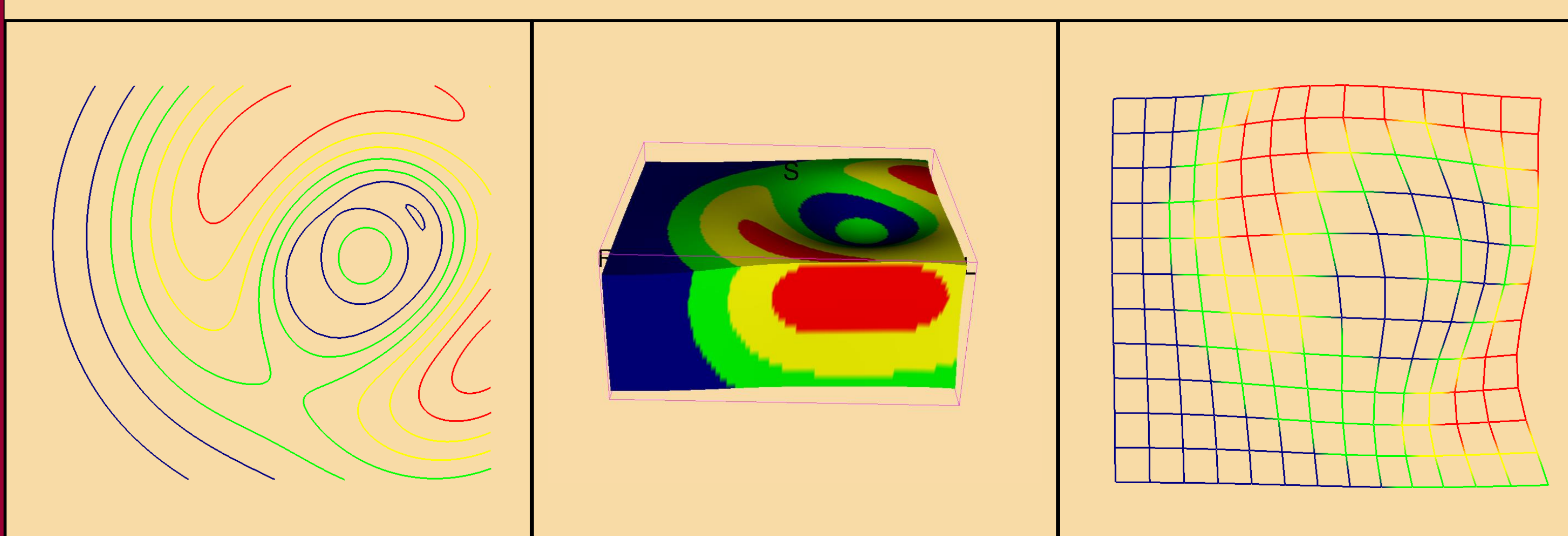
The transform visualizer takes as input any type of linear and non-linear transformation or a vector volume describing a displacement field. The transform visualizer creates visualizations that represent the displacement of a fixed volume to a moving volume with the transform or vectors applied to it. Having a variety of visualization modes and settings is important for being able to evaluate a wide variety of datasets. 2D visualizations can be overlaid on individual image slices whereas 3D visualizations give a better representation of the entire nature of a transform. Six visualization modes each with various parameters are available to the user.



3D Glyphs

2D Glyphs

3D Grid



Isolines (can be viewed as isosurfaces)

Block

2D Grid

Platform

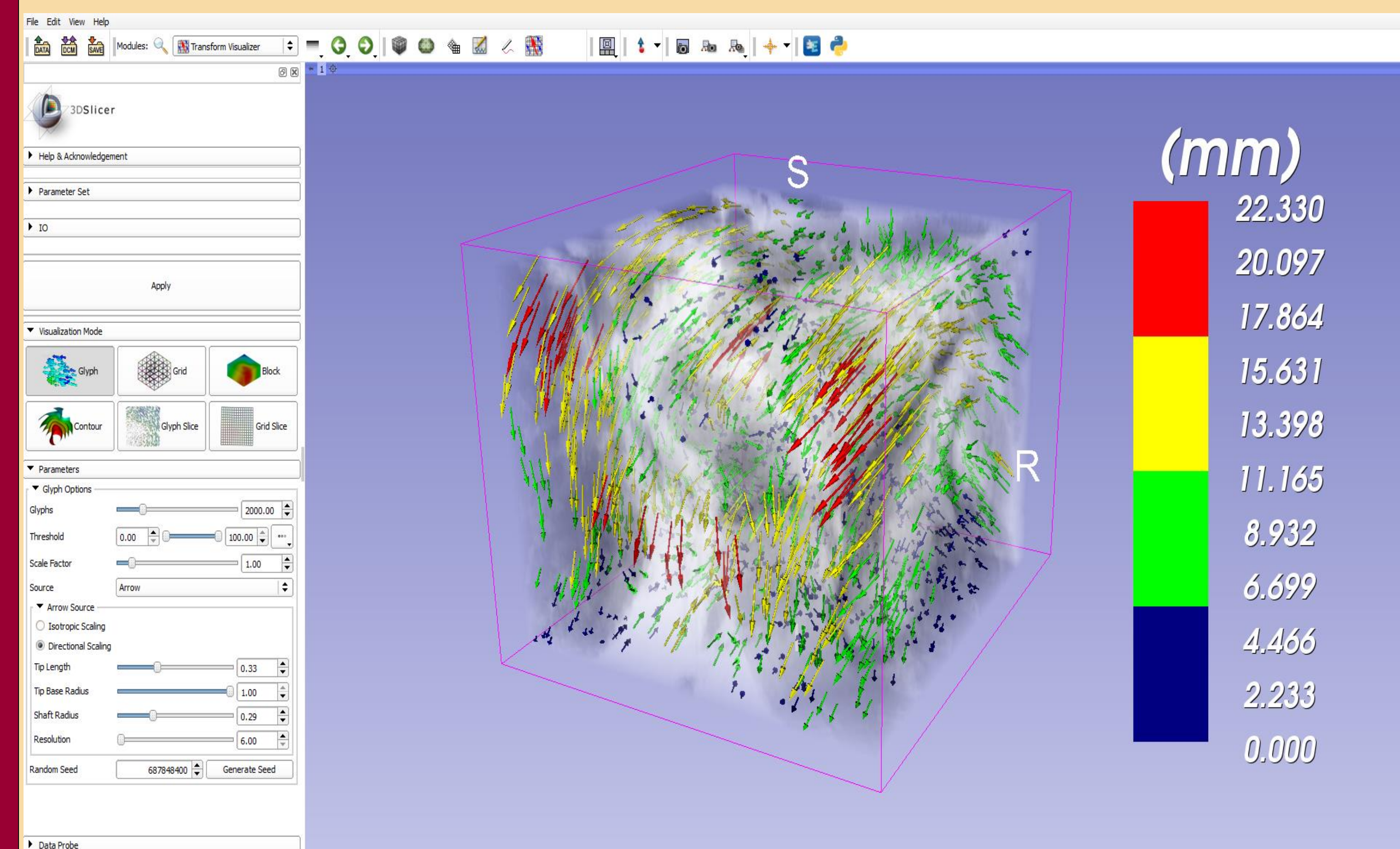
3D Slicer (www.slicer.org) was chosen as the platform for the transform visualizer tool

- Free, comprehensive, and open-source software package widely used for a variety of medical applications including image-guided interventions
- Includes state-of-the-art image registration algorithms
- Modular organization allowing for easy extension of functionality
- Integration allows for a user to take advantage of the software's many other features, including modification of color assignments and overlays of the visualization with models or images

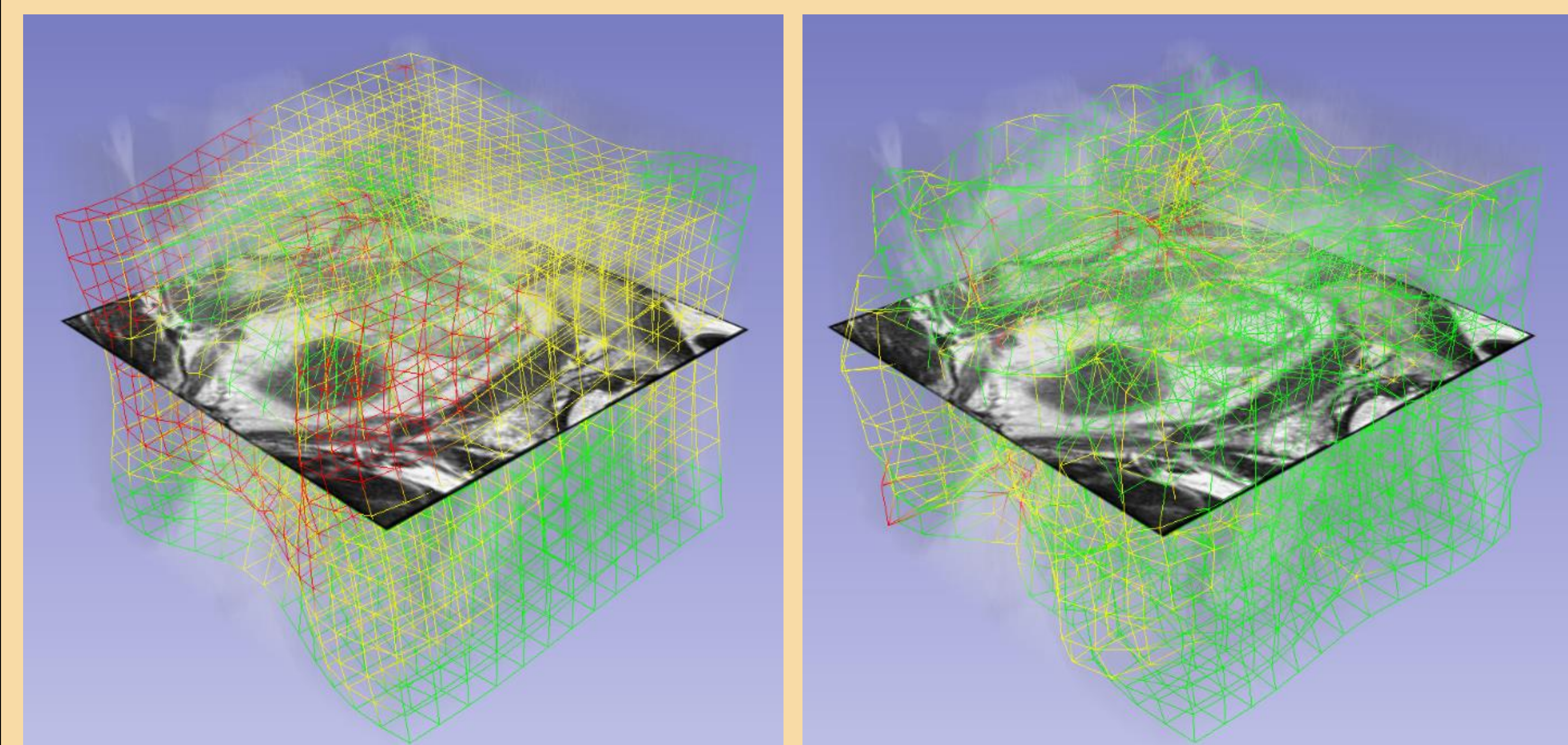
Results

Use Case

Visualizations generated from intraoperative patient data acquired during an MR-guided prostate biopsy procedure are shown. Various options such as thresholding and color mapping help to highlight regions of greater motion. Demonstrated is the use of the 3D grid mode to distinguish a failed overfitted registration from a successful registration.



Non-linear displacement visualized in 3D Slicer using the transform visualizer's glyph mode with directionally scaled glyphs



Results of a failed registration (right) and a successful registration (left) visualized using the 3D grid mode

Conclusion

A tool for the visualization of displacement fields was created and integrated into 3D Slicer, facilitating the validation of image registration algorithms within a comprehensive application framework suited for intraoperative use.

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