High-Performance Workflow Primitives for Image Registration and Segmentation

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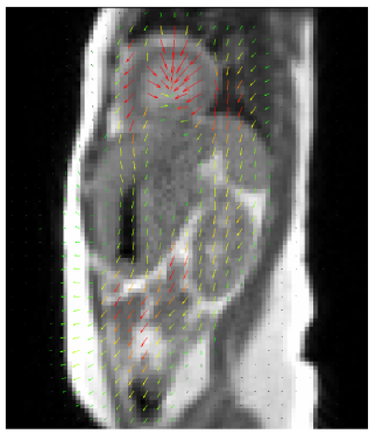
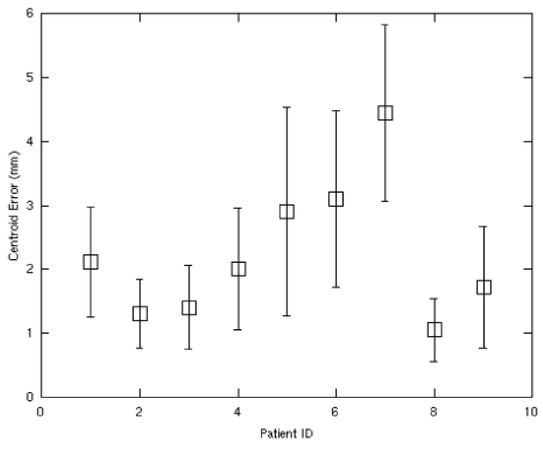
Project Motivation

Image registration and segmentation are vital enabling technologies for addressing many complex, data driven problems. Examples include individualized medical treatment where disease progression is monitored by analyzing MRI, CT, or ultrasound images over time; identifying anatomical structures in medical images; recognizing objects and people in video footage; and extracting imageable biometrics such as fingerprints, faces, and the iris. Images and videos can now be easily acquired at a rate that far surpasses our capacity to perform advanced image analysis. For this reason, advanced registration and segmentation algorithms are not routinely used for many large-scale and time sensitive applications because they require more processing time than is available.

Real-time Image Registration



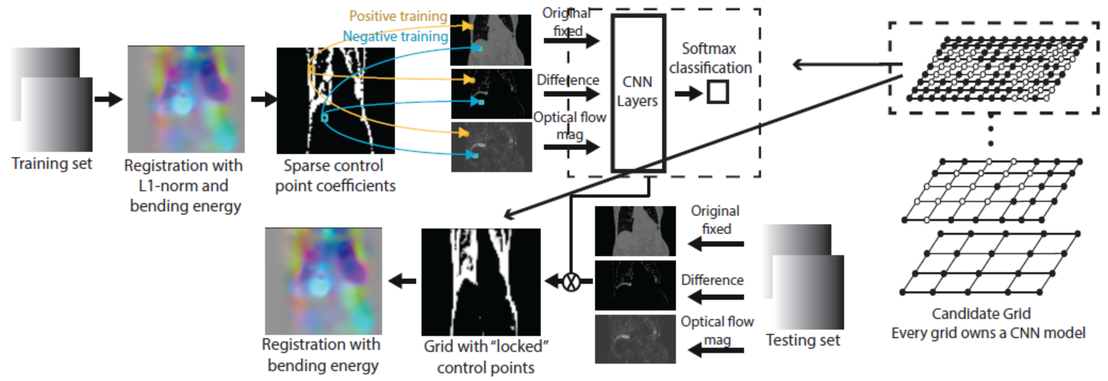
Example real-time deformable image registration result (left)



Difference between target centroid and manual contouring (mm) (right)

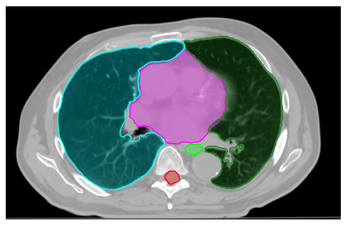
Cine-mode MR is an ideal imaging method for real-time therapeutic control. Our deformable image registration method can be computed in less than 200 ms, to enable real-time tracking of multiple soft-tissue targets. The intended application is automatic optimization of radiotherapy in the thorax and abdomen, to compensate for respiratory motion. *(Submitted, RSNA 2018)*

Multi-grid Image Registration



B-spline deformable image registration is well established for mapping 3D medical imaging volumes. B-spline coefficients can be optimized simultaneously at multiple resolutions using a multi-grid approach. Algorithm performance is boosted by detecting grid sparsity and removing unnecessary parameters from the coefficient grid. *(Accepted, CVPR 2017)*

Work in Progress



Automatic image segmentation methods use distance maps during training and classification. Drexel PhD students Shihao Song and Michael Spanier are developing high-performance methods to accelerate this important algorithm.

Contact and Visit

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