Abstract ID: 16899 Title: Tissue Dependent Deformation Field Regularization through Collapsed Cone Convolution/Superposition

Purpose

Previous Tissue-dependent deformation field filters incur a relatively high computation cost. We present a collapsed-cone based adaptive filtering method to reduce the computational overhead. Our proposed method is able to reduce the computational complexity of the superposition process from O(q3N3) to O(MN3) time, where q is the chosen neighborhood size, N is the volume dimension and M is the number of kernel axes.

Method and Materials

Our proposed filter performs diffusion along chosen kernel axes instead of within a size-limited cubic neighborhood. During the ray tracing process along the kernel axis, the contribution of a given voxel to its neighbors is exponentially attenuated to simulate the physical characteristics of tissues. During the attenuation, local biomedical information can be naturally incorporated by scaling the ray tracing length according to the underlying tissue stiffness. This scaling makes a voxel within soft tissues more ``malleable" with respect to its neighbors' movements.

Results

We integrated different regularization methods into the same deformable registration approach (Demons algorithm). The kernel size of the Gaussian filter was set to be 5; the number of kernel directions for the CC filter were 4 in 2D and 16 in 3D. The experiments shows that our results produces are no-worse result with a faster speed than these from other techniques. By investigating the finer details, the proposed method shows better capability of tracking changes.

Conclusion

Wpresented a collapsed-cone (CC) based technique for the regularization of the deformation fields in image registration, which provides realistic deformation field and is useful for studying and modeling organs in motion. Since the CC filter can cover the entire 3D volume of interest, a better maintenance of the overall object shapes can be achieved. The incorporation of tissue information allows the CC filter to adjust its behavior to match the tissue biomedical characteristics.