
Raya Horesh
**A Multi-grid framework for volume preserving
constrained image registration on OcTree structure**

Department of Mathematics and Computer Science
Emory University
400 Dowman Dr
Atlanta
GA 30322
USA
`rshindm@emory.edu`
Eldad Haber
Jan Modersitzki

Image registration is one of the fundamental missions of image processing. It can be simply considered as a process of aligning/matching two or more images having similar contents in some sense. For example, the images could have been captured at different times, from different viewpoints and/or using different types of sensors. Since the problem of image registration is ill-posed, one may wish to add additional information. In this study, the deformation is controlled in terms of the determinant of the Jacobian of the transformation. This approach guarantees regularity of the grid and prevent folding effects.

In order to keep the computational time reasonable, it is desirable to reduce the amount of data which need to be processed. This can naively be obtained by down-sampling. However, this approach may results in the loss of possibly important image features. OcTree provides a straightforward approach for such a context driven data sparsification. The OcTree data presentation uses few voxels for representing regions with small variability and many voxels for regions of high variability.

Discretization of the volume preserving constrained registration problem yields a KKT system. This large-scale system is indefinite and ill-conditioned; therefore, we propose a multi-grid framework for effective preconditioning of this system. We present mesh-size-independent results that demonstrate the optimality of the proposed method.