

FEM-BASED VARIATIONAL DISCRETE DEFORMABLE REGISTRATION

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DESCRIPTION OF THE METHOD

We applied our previously proposed finite element method (FEM) based discrete deformable registration algorithm (Popuri et al. 2013), that uses a variational formulation of the random walker (RW) registration method (Cobzas and Sen 2011) on EMPIRE 10 challenge data set. The specific details of our implementation are as follows:

- The moving image was linearly registered to the fixed image using the FSL flirt program (Jenkinson and Smith 2001), (Jenkinson et al. 2002) using the sum of squared similarity measure and a 12 degrees of freedom (DOF) affine transformation.
- One of the important aspects of our FEM-based discrete deformable registration algorithm is an image-adaptive non-uniform discretization of the problem domain. Following the image-adaptive meshing strategy described in (Popuri et al. 2013), we generated a non-uniform mesh on the lung masks corresponding to each of the fixed images.
- We implemented our FEM-based discrete registration method in a multi-resolution framework with 4 levels. The range of displacements used in each of the 4 levels are as follows: $[0, \pm 0.125, \dots, \pm 0.5]^3$, $[0, \pm 0.25, \dots, \pm 1.0]^3$, $[0, \pm 0.5, \dots, \pm 1.5]^3$, $[0, \pm 1.0]^3$.
- We chose the Perona-Malik (Perona and Malik 1990) diffusivity and set $\alpha = 1.0$, $\beta = 10$ in our proposed method for all the scan-pairs.
- We ran the experiments on a Intel i7 3.60 GHz machine with 64GB RAM.

REFERENCES

- Cobzas, D. and Sen, A. (2011). “Random walks for deformable image registration.” *Medical Image Computing and Computer-Assisted Intervention—MICCAI 2011*, 557–565.
- Jenkinson, M., Bannister, P., Brady, M., and Smith, S. (2002). “Improved optimization for the robust and accurate linear registration and motion correction of brain images.” *Neuroimage*, 17(2), 825–841.
- Jenkinson, M. and Smith, S. (2001). “A global optimisation method for robust affine registration of brain images.” *Medical image analysis*, 5(2), 143–156.
- Perona, P. and Malik, J. (1990). “Scale-space and edge detection using anisotropic diffusion.” *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, 12(7), 629–639.
- Popuri, K., Cobzas, D., and Jagersand, M. (2013). “A variational formulation for discrete registration.” *Medical Image Computing and Computer Assisted Intervention (MICCAI)*.

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