SCIENTIFIC COMPUTING AND IMAGING INSTITUTE

ShapeWorks Documentation

ShapeToolKit : Alignment Tools Documentation

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Abstract

This document covers the alignment and registration based tools for both images and meshes.

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1 License

ShapeWorks and its graphical user interface ShapeWorksStudio are available for free and are open source under the MIT License. For more information, please refer to `https://www.sci.utah.edu/software/shapeworks.html`.

2 Acknowledgement

If you use ShapeWorks and/or ShapeWorksStudio in work that leads to published research, we humbly ask that you add the following to the 'Acknowledgments' section of your paper: *"This project was supported by the National Institute of General Medical Sciences of the National Institutes of Health under grant number P41 GM103545-18."*

3 Alignment Tools

3.1 Center of mass alignment (images)

Takes in a binary volume and translates the center of mass of the shape to the center of the 3D volume space or to any user defined center.
The command line tool can be used as follows:

./TranslateShapeToImageOrigin –inFilename $1 –outFilename $2 –MRIinFilename $3 –MRIoutFilename $4 –useCenterOfMass $6 –centerX $7 –centerY $8 –centerZ $9

The parameters are as follows

1. inFilename : Input image file name
2. outFilename : Output image file name
3. MRIinFilename : MRI image file name
4. MRIoutFilename : MRI output image file name
5. useCenterOfMass : Flag to be set as 1 to use center of mass, if 0 then it translates the image center
6. centerX : (Optional) Specified X coordinate of center of the final output (Default = Image Center)
7. centerY : (Optional) Specified Y coordinate of center of the final output (Default = Image Center)
8. centerZ : (Optional) Specified Z coordinate of center of the final output (Default = Image Center)

3.2 Rigid ICP based 3D image registration

./ICPRigid3DImageRegistration -targetDistanceMap $1 -sourceDistanceMap $2 -sourceSegmentation $3 -icpIterations $4 -isoValue $5

A command line tool that performs iterative closed point (ICP) 3D rigid registration on a pair of images.

It uses the following input arguments:

1. targetDistanceMap: the distance map of target image.
2. sourceDistanceMap: the distance map of source image.
3. sourceSegmentation: the segmentation of source image.
4. isoValue: as we need to get point set from surface for ICP, this iso value is required to get the isosurface. The default value is 0.0.
5. icpIterations: the number of iterations user want to run.

We in the provided automated scripts use ANTS based packages to perform registration.

3.3 Rigid ICP based surface mesh registration

Performs iterative closed point (ICP) rigid registration on a pair of vtk meshes.

It uses a parameter file that would enable to specify the source mesh (moving) and the target mesh (fixed) to be used to estimated the rigid transformation matrix then apply the same transformation on other meshes defined in the source mesh domain to be mapped to the target domain. The usage therefore is just
./ICPRigid3DMeshRegistration parameterFile.xml parameter file tags are as follows:

1. source_mesh: vtk filename of the moving mesh
2. target_mesh: vtk filename of the fixed mesh
3. out_mesh : vtk filename of the aligned moving mesh to be save
4. out_transform : txt filename to save the estimated transformation
5. source_meshes: (optional) a list of vtk filenames for meshes defined in the source mesh domain to be mapped to the target domain using the same transformation matrix estimated.
6. out_meshes : a list vtk filenames to save source_meshes after applying the transformation matrix.
7. mode : Registration mode rigid, similarity, affine (default: similarity)
8. icp_iterations: number of iterations
9. debug: verbose debugging information
10. visualize: display the resulting alignment