

## Feature-Based Correspondences to Infer the Location of Anatomical Landmarks

A methodology has been developed for automatically determining inter-image correspondences between cliques of features extracted from a reference and a query image. Cliques consist of up to three features and correspondences between them are determined via a hierarchy of similarity metrics based on the inherent properties of the features and geometric relationships between those features. As opposed to approaches that determine correspondences solely by voxel intensity, features that also include shape description are used. Specifically, medial-based features are employed because they are sparse compared to the number of image voxels and can be automatically extracted from the image.

The correspondence framework has been extended to automatically estimate the location of anatomical landmarks in the query image by adding landmarks to the cliques. Anatomical landmark locations are then inferred from the reference image by maximizing landmark correspondences. The ability to infer landmark locations has provided a means to validate the correspondence framework in the presence of structural variation between images. Moreover, automated landmark estimation imparts the user with anatomical information and can hypothetically be used to initialize and constrain the search space of segmentation and registration methods.

Methods developed in this dissertation were applied to simulated MRI brain images, synthetic images, and images constructed from several variations of a parametric model. Results indicate that the methods are invariant to global translation and rotation and can operate in the presence of structure variation between images. The automated landmark placement method was shown to be accurate as compared to ground-truth that was established both parametrically and manually. It is envisioned that these automated methods could prove useful for alleviating time-consuming and tedious tasks in applications that currently require manual input, and eliminate intra-user subjectivity.

**Keywords:** feature-based correspondences, anatomical landmark placement, medialness, the correspondence problem, similarity metrics.