

Co-registration and fusion of CT and SPECT images

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Abstract:

We present an automatic and accurate technique for 3D co-registration of Single Photon Emission Computed Tomography (SPECT) and Computed Tomography (CT) in order to allow for the attenuation correction of SPECT images and for the fusion of the anatomic details from CT and the functional information from SPECT.

Methods: The goal of medical image registration is to find the spatial transformation that maximizes the similarity between two images and brings their corresponding anatomical landmarks into alignment. Within the registration framework provided by Insight Toolkit, we used the mutual information similarity metric to evaluate the accuracy of the alignment. Before registration, an initial translation was applied to the SPECT image to align the centers of gravity of both images. To improve the robustness and accuracy of the registration algorithm, a multi-resolution approach was used in which registration is performed in a coarse-to-fine manner. During registration, the metric value is optimized over the parameter space defined by the translation parameters using a gradient-descent minimization scheme.

Results: we applied the algorithm to four clinical data sets originated from two pelvic studies, one cardiac study, and one thoracic study. Validation was done by inspecting the 2D and 3D fusions of the registered images and by observing the convergence in the similarity metric and the transformation parameters. We also evaluated quantitatively the effect of initial misalignment of the paired volumes and the reproducibility of the registration. In all studies, registration with multi-resolution converged close to a final alignment with translational error 0.512mm /- 1.91 mm. When multi-resolution is used, an initial alignment was not needed for all cases except for the cardiac study. The average computation time (on a 3.0GHz PC) was < 4 minutes for the entire registration procedure.

Conclusion: we have developed an automatic technique for the linear registration of CT and SPECT images.