AbstractID: 9415 Title: Spatial Weighted Mutual Information for Image Registration in Image Guided Radiation Therapy

Purpose:

To develop a robust registration algorithm for medical images, emphasizing the registration of plan images with cone beam computed tomography (CBCT) images for IGRT. Our Spatial Weighted Mutual Information (SWMI) technique assigns greater importance to user-selected volume, allowing medically 'important' areas to dominate the registration process.

Methods and Materials:

Mutual Information (MI) is the most popular measure of image registration due to its robustness and multi-modal capability. However, MI does have difficulty where organ deformation is present. We reformulated the MI algorithm by incorporating an adaptable weight function to user selected spatial locations. Since MI is defined in probabilistic space, we proposed a spatial-weighted joint probability, and composed a Spatial Weighted Mutual Information measure. Our image registration software and Graphical User Interface (GUI) was programmed in C++ to import DICOM images and DICOM-RT information, and to perform image registration. For this study, we used Gaussian-shaped spatial weights applied to a user-defined volume. Our software allows a user to adjust the Gaussian parameters via the GUI. Convergence and robustness of our registration method was first tested with a head-and-neck plan and seven CBCT image sets. Then, a prostate plan with nine CBCT image sets was analyzed. Speed of convergence was tested by arbitrarily miss-aligning two image sets ±15mm over 41 trials. We also applied our algorithm to fuse CT and MRI image sets.

Results and Discussion:

Image registration using our measure converges 10% faster than using Mutual Information. Our study showed image registration using a uniform weight over an entire volume lead to compromised target coverage. SWMI showed better alignment near target areas and neighboring critical organs even with organ deformation. Our method worked well in fusing MRI to CT images as well.

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