

AbstractID: 13978 Title: A New Image Guided Radiation Therapy Scheme using Spatially Weighted Mutual Information Image Registration and a Semi-automatic PET Segmentation Tool

Purpose:

To enhance the automatic image registration process for Image Guided Radiation Therapy (IGRT) using biological information acquired by PET imaging.

Methods and Materials:

We developed an image registration tool which is incorporated with a three-dimensional semi-automatic segmentation tool for Positron Emission Tomography (PET) image set. Firstly we registered PET image set to the planning CT image set. Contours for the high uptake volumes were generated by a semi-automatic segmentation tool. User can choose an intensity profile with a pointing device in Graphical User Interface. Then, region growing algorithm was utilized. Threshold for segmentation can be adjusted in GUI. We exported the segmented volumes and fused into a DICOM-RT structure set generated in a planning CT.

We formulated Spatially Weighted Mutual Information (SWMI) image registration with Structure-Of-Interest (SOI) based weight function (SWMI-SOI) because assigning various importance weight values to geometric locations is not possible with mutual information image registration. SWMI method allows the user can assign the importance weights through the geometric space. A user can choose how much importance weight will be assigned to each SOI. We expanded the organ contours so that each SOI included enough image features such as organ edges.

We assigned the higher importance value to Clinical Target Volumes (CTV) and the Organs-At-Risks (OAR). The highest importance value was assigned to the volumes which were delineated using PET segmentation tool. Lower weight values were assigned to other structures so that they would not dominate the registration. This insures that PET defined volumes will get a full treatment dose in every fraction.

Results and Discussion:

We successfully used biological information in IGRT process and SWMI-SOI registration algorithm. Our method showed consistency between users and was very useful when multiple lesions were considered during image registration process. Further clinical research is necessary to determine optimal weight assignment.