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Frequency Based Portal Image Registration for Radiotherapy Treatment

In External Beam Radiotherapy (EBRT), one cancer treatment method, external source of radiation is directed at the tumor from an external source produced by linear accelerator (LINAC). EBRT consists of two major parts; planning and treatment phases. In the planning phase, the shape and location of the tumor is determined by a simulator and in the treatment phase high energy beams irradiate the tumor. Reducing patient positioning uncertainty for each fraction of treatment process is crucial for both cancerous and healthy cells. To reduce geometric error, increasing the frequency of treatment verification with portal imaging would be an effective method. Portal images are taken with linear accelerator devices with therapeutic beams. Patient positioning problem could be considered as an image registration problem between the images taken during the planning phase and the ones taken during each treatment fraction (portal images). Images taken by therapeutic beams have low resolution and contrast. Limited contrast adaptive histogram equalization is used to enhance their quality. The major focuses of our method are log-polar and Fourier transforms properties.

Log-polar transformation converts scaling and rotation into translation; so we can deal with any angle of rotation and large scaling in the log-polar domain. To recover the parameters of the affine transformation, we map frequency domain to the log polar space and as an optimization method the normalized cross power spectrum of mapped portal and reference image is calculated. The scale and rotation will be recovered and phase correlation method will be used for determining translation.