AbstractID: 8200 Title: Tracking of brachytherapy source position using emission imaging

Purpose:
To construct an imaging system that uses the exit radiation from a brachytherapy source during treatment. This system uses a single flat panel detector (FPD) and is capable of tracking the source position in 3D space, with no extra imaging radiation source or extra radiation dose to the patient.

Method and Materials:

It uses one a-Si FPD and BB tray. The BB plane is parallel to detector surface and has multiple BBs embedded with mechanical accuracy. When illuminated by an Ir-192 HDR source, the BBs cast shadows on FPD. Based on the geometric relation between the BBs and FPD, coordinates of HDR source in 3D were derived:

$$x_s = x_{f1} x_{b2} / (x_{f2} - x_{f1} - x_{b2}),$$
$$y_s = y_{f1} x_{b2} / (x_{f2} - x_{f1} - x_{b2}),$$
$$z_s = -h x_{b2} / (x_{f2} - x_{f1} - x_{b2}),$$
$$y_{f1} = y_{f2},$$

where z is perpendicular to FPD, s denotes HDR source, f denotes FPD, 1 and 2 refer to two different BBs.

A kVp source at 3.3 meters away was used to align the center BB with the center pixel on FPD. Image acquisition time was between 3 and 6 seconds per projection. For a HDR test plan of 11 dwell points, one projection was taken for each dwell point and the shadow of the BBs were manually identified from the projection images.

Results:
The 3D coordinates for the 11 dwell positions of the test HDR plan were all successfully reconstructed based on two BBs. As a simple consistency check, the relative distances between dwell points were compared with the expected values. The average of the difference is less than 0.05 cm with a standard deviation of 0.16 cm.

Conclusion:
With automated BB shadow recognition and faster FPD, this technique possesses the potential of tracking 3D trajectory of a brachytherapy source in real time, for real time position verification or dose reconstruction.