Purpose:
CT and MR imaging has been widely accepted as a practical approach for both accurate delineation (using MR data) and dose calculation (using CT data) for image-guided radiotherapy (IGRT) of prostate cancer. This work investigates the accuracy of CT and MR fusion in target (prostate) delineation for prostate IGRT treatment planning.

Methods:
Twenty prostate patients were included in this study. Each patient underwent CT- and MR-simulation prior to the IMRT or RapidArc treatment. Paired CT-MR images were obtained on a GE 4D CT scanner and a GE 1.5T MR scanner in our department. MR and CT scans were performed within 30min to minimize organ or structure changes except for patients implanted with Calypso Beacons who received MR scans prior to their Beacon implantation and CT scans 1 week after. External contour variations were quantified from the isocentric slices on both CT and MRI images. Prostate volume was used to evaluate the accuracy of image fusion, which was mainly based on bony structure matching.

Results:
The maximal differences in lateral dimensions ranged 0.1 to 1.2 cm for patients with lateral dimensions of 33.0 –52.4 cm. The vertical dimensions differed by 0.1 - 1.4cm for patients with vertical dimensions of 18.8 –33.1 cm. In general, the contour variations increased with the patient size. There was a residual fusion error for the prostate gland ranging from 0.1 to 0.5cm (average 0.16cm) after bony structure matching. Mismatch occurred when there was a large difference in the bladder/rectal volume between CT and MRI.

Conclusions:
Large contour variations may occur for large patients due to obesity, which should not change the planning dose distribution significantly. On the whole, the geometrical distortion and target shift between CT and MR images are not obvious and mostly clinically insignificant for treatment planning assuming a fusion uncertainty of 2mm.