Purpose: In order to increase the accuracy and speed of catheter reconstruction in an HDR prostate implant procedure, an automatic tracking system has been developed using an electromagnetic device. The performance of the system was investigated.

Methods: A transmitter with detection range of 36 cm and a sensor with diameter of 0.9 mm were used for needle position tracking during a HDR prostate implant. Due to substantial interference in the electromagnetic field from the surgical table, implant stepper/stabilizer etc, a calibration algorithm using a scattered data interpolation scheme was implemented to correct tracking location error. Reproducibility of the calibration algorithm was determined under various equipment arrangements. A QA phantom with straight catheters was constructed for deriving calibration profiles, and for investigating the accuracy of the system. Tracking of catheter positions was conducted at distances between 140 mm and 280 mm from the transmitter. In addition, the QA phantom was inserted 17 needles with curved trajectories to simulate a typical prostate implant. Needle reconstruction time was recorded and compared to general ultrasound reconstruction times while reconstruction positions were compared to CT reconstructions of the phantom to validate the system.

Results: Average tracking accuracies after calibration were 0.4 ± 0.3 mm and 2.4 ± 1.7 mm without calibration. The max standard deviation was 0.9 mm in the test range for the reproducibility test. The total tracking time for the 17 catheters was less than 4 minutes and the reconstruction result matches CT data within 2.0 mm.

Conclusions: Compared to conventional ultrasound based real-time catheter reconstruction method in the HDR prostate implant, the system can reduce the error from > 3 mm to < 1.5 mm, shorten the time from 15-60 minutes to < 4 minutes. Furthermore, this technique can also be used for other HDR implants.