choosing this mono-energy, it is possible to achieve MAR in patients with hip prostheses. This approach is simple and easy to implement. The goal of this study is to assess the MAR capacity of DECT in the context of LDR seed implants. More specifically, we aim to ascertain whether the use of DECT can yield dose calculations whose accuracy is not marred by metal artefacts.

**Materials and Methods:** DECT imaging at 100 kVp and 140 kVp was performed on an ultrasound phantom designed for prostate implants containing inert LDR brachytherapy seeds. The magnitude of artefacts was evaluated as a function of mono-energetic attenuation maps by comparing the standard deviation (\(\sigma\)) of the density map obtained from the standard DECT mono-energetic image. The increased noise in the density map can be alternately that the density map corresponds to the best high keV artefact/mono-energetic image. The increased noise in the density map can be reduced by optimizing the separation of the high and low kVp spectra. Mono-energetic images from DECT with a high keV to 150 keV, as can be seen in figure 1C. The ratio of \(\sigma_{\text{artefact}}/\sigma_{\text{mono}}\) is plotted for the ROIs seen in Figure 1A. The \(\sigma_{\text{artefact}}/\sigma_{\text{mono}}\) from the density map is plotted as a horizontal line. Our results suggest that the MAR from the density map from \(\sigma_{\text{artefact}}/\sigma_{\text{mono}}\) decomposition is better than the mono-energetic images, or alternately that the density map corresponds to the best high keV mono-energetic image. The increased noise in the density map can be reduced by optimizing the separation of the high and low kVp spectra.

**Conclusions:** Independent validation of high dose rate (HDR) brachytherapy source localisation using an EPID

**Purpose/Objective:** Brachytherapy provides one of the best cure rates for the treatment of prostate cancer but is highly skill dependent. An interactive electromagnetic needle navigation system was developed to reduce uncertainty in the implant procedure and expand the capabilities of patient-specific implant techniques.

**Materials and Methods:** A gelatin phantom was placed inside the work space of a magnet field generator device which tracks the 3D locations of small EM-signal-producing coils. These coils were placed on the end of an endorectal ultrasound probe, upon the probe stepped and embedded within the wall of a 16 gauge brachytherapy needle. The needle allows passage of a standard prostate brachytherapy seed. These coils provide real-time patient, probe, and needle coordinates. Additionally, the system has a mechanism by which the 3D coordinate and time information provided by the EM tracking device at the moment the seed is deposited in tissue can be automatically recorded. Experiments were performed to qualitatively determine the usability of the navigation system, as well as to measure the accuracy of the automated seed localisation. Multiple seed implants were performed upon a phantom and the automated EM coordinates were compared to the ‘true’ locations, as determined by a CT scan. These two coordinate systems were co-registered using a CT marker placed on the side of the phantom, for which the location was determined using the EM tracked needle by placing the tip upon opposite sides of the marker and averaging the locations’ coordinates. The precision of the seed localisation is determined by evaluating the differences in relative seed locations within each coordinate system.

**Results:** The system hardware, interface, and workflow validation experiments were implemented to demonstrate that EM needle tracking can guide implantation of seeds with minimal user expertise. Trials with the EM system have shown, qualitatively, an increase in usability and ease of needle navigation. Preliminary results also indicate the EM tracking seed localisation is precise to 2.7 mm (1 sigma).

**Conclusions:** A system has been developed to assist the placement of radioactive seeds for the treatment of prostate cancer and reduce the dependence on physician skill-level, as well as facilitate skew-line needle arrangements and allow for improved mid-procedure re-optimization based on seed deposition errors. The system will help reduce the number of attempts to bring a needle to the correct seed dropping location as well as facilitate the use of alternative needle pattern for organ sparing. Additionally, automated seed dropping detection will allow the system and user to know immediately the seed location and thereby adjust accordingly. Clinical implementation will be needed to determine the extent of increased precision and reduced trauma.

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Independent validation of high dose rate (HDR) brachytherapy source localisation using an EPID

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**Purpose/Objective:** We have previously shown that a flat panel imager can be used for source position localisation in HDR brachytherapy. Analysis of the EPID image distribution can be used to determine the source position relative to the EPID, but needed to be validated independently. Here we describe a method for the independent validation of source position coordinates determined in the two orthogonal directions parallel to the imager, using a novel projection technique combined with HDR source radiation subtraction.

**Materials and Methods:** An a-Si EPID (IAS11-19, Varian Medical Systems, Palo Alto, CA, USA), removed from a linear accelerator, was positioned in contact with a rectangular solid water phantom, which included a ball-bearing array, placed against the surface of the imager. Brachytherapy catheters were inserted into grooves cut into a phantom slab at a distance of 50 mm from the imager surface. A mobile x-ray unit was set up at a relatively large distance (1500 mm) from the imager. Radio-opaque x-ray source position markers were inserted into the catheters and a projection image acquired using the external x-ray source and the EPID. At each dwell position two images were acquired: the first capturing only the radiation emitted by the Ir192 source, while the second image acquired also contained an exposure from the external x-ray system. Using image subtraction, the position of the projection of the physical Ir192 source could be determined and correlated with the marker projections (See Figure 1). To account for beam divergence effects, the distance of each projection from the central axis (CAX) of the external x-ray beam was determined. A stereotactic angiographic localisation frame was used as a set of known orthogonal pairs of radio-opaque markers, with the CAX determined by co-location of the perpendicular pair in the image.

**Results:** The centroid coordinates of marker and source projections were derived and used to calculate object locations via geometric back-projection. Marker locations and the HDR source itself, identified using the subtraction method described here, were determined to within ±0.4 mm (± half of the pixel size) at each programmed dwell position. Derived source positions matched the marker positions.