Dynamic CT scanner environment effects on a DC electromagnetic tracking system

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Purpose

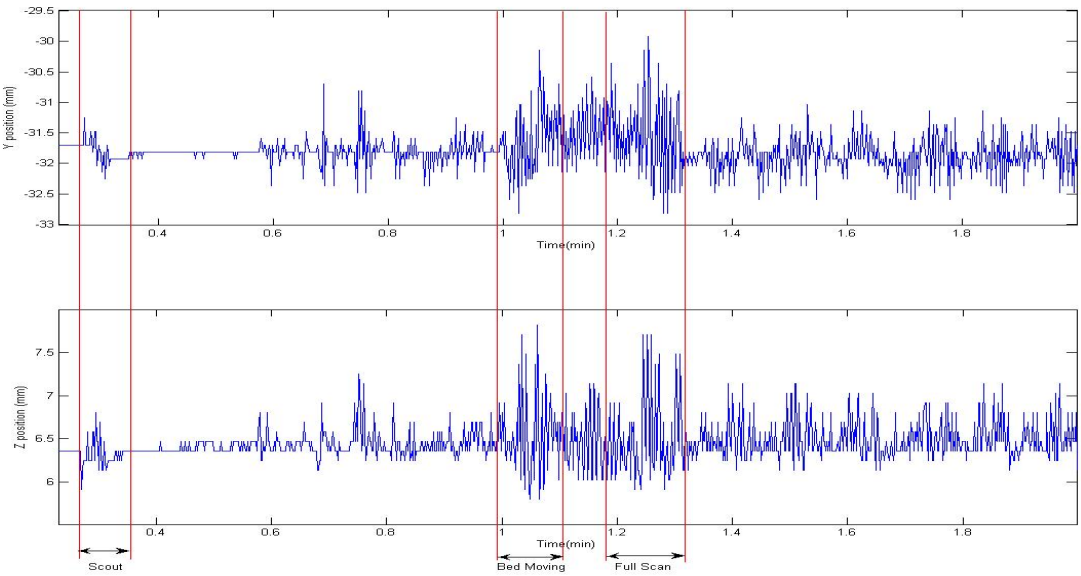
Electromagnetic (EM) trackers provide a steady stream of highly accurate data on instrument position, needing only to be registered to imaging data to provide simple, intuitive displays to guide the operator. Several investigators[1,2] have evaluated the potential for the interference of the CT environment with the performance of electromagnetic trackers. However, there are few extant studies of the effects on tracker performance during scanning or closely integrated into the scanning operation. The purpose of this study is to evaluate the performance of current state of the art DC EM trackers during the operation of a CT scanner to measure the accuracy, induced noise, and stability of the tracker signals during different phases of a typical CT scanning procedure.

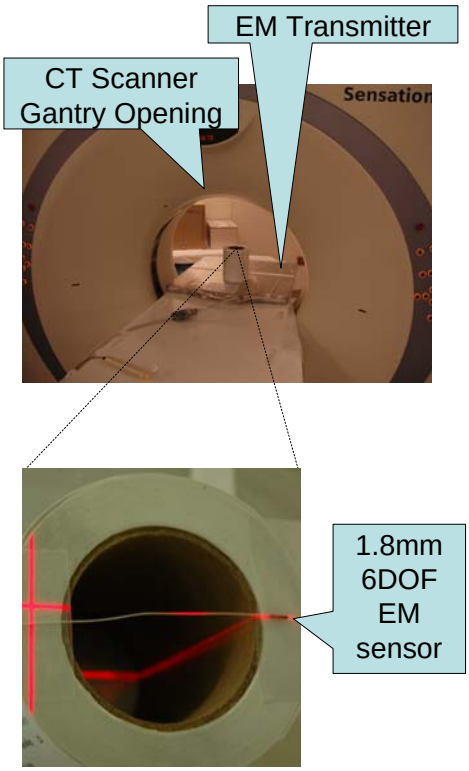
Electromagnetic Tracking Signals During a Typical CT Scan Cycle

Gantry Off

CT Scanner Gantry is Rotating

The background noise level was observed to increase significantly while the scanner gantry was moving.





Experiment

Evaluate EM sensor readings during a scanning protocol to reproduce the conditions under which the sensors would operate in a clinical procedure.

Methods

An Ascension Technologies flatplate MedSAFE EM transmitter was placed on the patient table and the 1.8mm 6DOF EM sensor was fixed in the working volume of the transmitter. The x-axis of the transmitter lay normal to the scanner bed and the y-axis spanned the table in the lateral direction. At all times during the scanning protocol, the sensor was fixed in relation to the transmitter.

Results

With the gantry off, the sensor readings reached a maximum variation of 1.0mm in the y-axis during the scout image. At this point, the patient table was moving. With the gantry on, the sensor readings reached a maximum of 2.9mm in the y-axis during the CT scan. At this point, the patient table was moving.

Summary

We have demonstrated that a CT scanner induces increased variability in EM sensor readings and that the effect is more severe when the CT gantry is rotating.

The implication for CT guided procedures includes the requirement to always take measurements under the same CT operation conditions, in a well tested, stable protocol. We further recommend stopping the gantry motion when a precision measurement is required.

References

1. Shen E, Shechter G, Kruecker J et al. Quantification of AC electromagnetic tracking system accuracy in a CT scanner environment. Proc. SPIE 6509, 65090L (2007).
2. Shen E, Shechter G, Kruecker J et al. Effects of sensor orientation on AC electromagnetic tracking system accuracy in a CT scanner environment. Proc. SPIE 6918, 691823 (2008).

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