

# Electromagnetic (EM) Comparison of the Medtronic AXiEM™ and Northern Digital Aurora™ Systems

Based on the research of K. Schicho, M. Donat, M. Figl, R. Seemann, W. Birkfellner, R. Ewers<sup>1</sup> and S. Hartmann<sup>2</sup>

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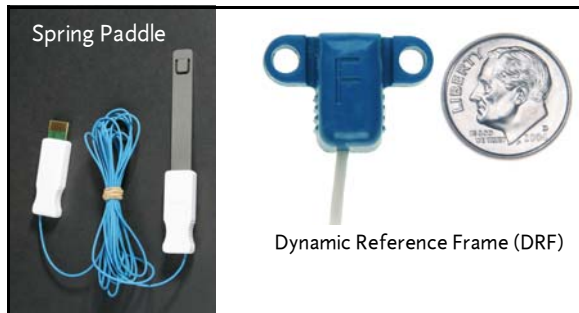
## 1. Introduction

Electromagnetic (EM) navigation functions by creating a magnetic field of known intensity in the surgical space and reading the strength of that field with a sensor. These sensors are integrated into the surgical instruments and measure the strength and direction of the magnetic field. They are able to detect distortions in the field and track large devices such as fluoroscopes. EM navigation is able to be adapted for a seamless integration into the OR and normal workflow. As a result, the use of EM in orthopaedics leads to less trauma due to fewer pin sites for the patient.

## 2. Materials and Methods

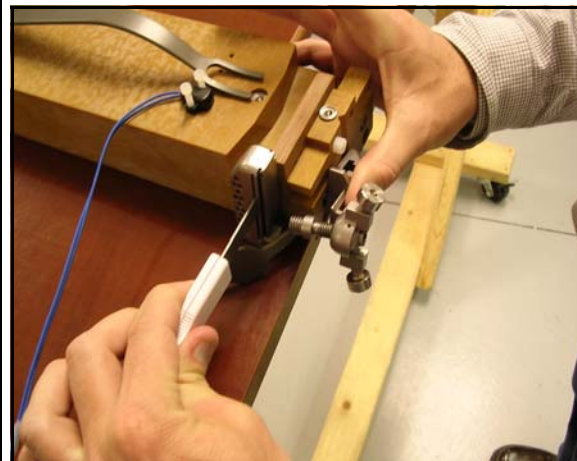
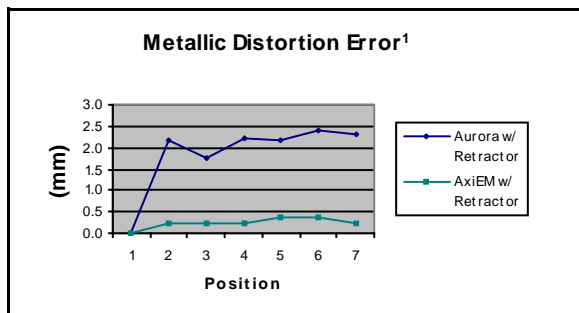
During recent testing, a third party comparison was conducted, focusing on the metallic distortions in two EM tracking systems: the Medtronic AXiEM system and the Northern Digital Aurora system. The evaluation tested the influence of "realistic OR conditions" on accuracy and stability, including the Langenback retractor and a drill. Multiple instrument positions were tested.<sup>1</sup>

A second in-house comparison was conducted, testing the AXiEM system and the Aurora system to determine position accuracy, orientation accuracy, accuracy in the presence of metallic interference, and overall computer-assisted surgery (CAS) system accuracy. Data on the position accuracy test was acquired over a 450 mm<sup>3</sup> volume using a total of 6859 points. The data was then analyzed to determine any change in performance over smaller volumes. To determine orientation accuracy, 428 samples were taken. The angle between two coils and the mean angle between coils were measured and compared. Accuracy in the presence of metal was tested by comparing the reference position and orientation before and after metal was introduced. A standard test was used to determine overall system-level accuracy.<sup>2</sup>



Dynamic Reference Frame (DRF)

## 3. Results



EM Accuracy Test Fixture

1. The position accuracy of the AXiEM system was determined to be **31% better** than the Aurora system on average. In reduced volume, the AXiEM system performed up to **41% better** in comparison to the Aurora system's performance.<sup>2</sup>

2. In testing the orientation accuracy of the two systems, the AXiEM system showed a mean orientation error **16% better** than the Aurora system, and a 99% confidence interval **70% better** than the Aurora system.<sup>2</sup>

3. The accuracy in the presence of metal test showed that the AXiEM system performed **60% better** for position accuracy and **40% better** for orientation accuracy.<sup>2</sup>

4. The results for the CAS system level accuracy showed the mean error of the AXiEM system was over **45% better** than the Aurora System.<sup>2</sup>

	<u>AXiEM</u>	<u>Aurora</u>
Mean	0.71	1.30
Standard Deviation	0.34	0.96
<b>99% Confidence Int.</b>	<b>1.74</b>	<b>4.17</b>
Max	1.59	4.31

System Level Accuracy Results from Standard Test in millimeters

## 4. Conclusions

The Medtronic AXiEM technology is significantly (more than twice the accuracy at 99% confidence) more accurate than the Northern Digital Aurora system in position accuracy, and in orientation accuracy (varus, valgus, etc), which is critical to orthopaedic applications and it is as much as 70% more accurate. Proprietary transmission technology enables the Medtronic AXiEM to perform better in the presence of metal, such as those devices introduced in the clinical setting, than the Northern Digital Aurora system.

## 5. References

1. "Evaluation of two newly developed commercial electromagnetic tracking systems." September 19, 2004  
Kurt Schicho, Rudolf Seemann, Rolf Ewers (University Hospital of Cranio-Maxillofacial and Oral Surgery), Markus Donat (University Clinic of Neurosurgery), Michael Figl, Wolfgang Birkfellner (Department of Biomedical Engineering and Physics). Medical University of Vienna, Austria
2. "Accuracy assessment of Electromagnetic Tracking Systems" Medtronic Navigation Technical Report, August 6, 2004  
Steve Hartmann.