Introduction of an open source middleware for automatic FOV adjustment in interactive MRI according to a medical tracking-system

Felix Güttler¹, Peter Krauß², Jonathan Guntermann², Andreas Heinrich¹, Ulf Teichgräber¹, ¹Department of Radiology, University Hospital Jena, Jena, Germany, ²Department of Radiology, Charité, Berlin, Germany, felix.guettler@med.uni-jena.de

Introduction

In real-time MRI-guided interventions and surgery [1], the field-of-view (FOV) of interactive sequences needs to be permanently changed according to the instruments movement. Dynamic tracking [2] allows the automatic adaption of the FOV to the instruments location acquired by a medical tracking-system. To accomplish manufacturer independent use of dynamic tracking, a middleware was developed allowing the use of various MRIs and tracking-systems.

Methods

The middleware provides unified navigation services for various tracking-systems (i.e. NDI Polaris) and MRI scanners (i.e. Philips HFO). Positioning data from target objects is transformed to MRI specific matrices. The MRI adjusts the FOV accordingly and acquires an image, which is returned to the middleware. The use of the system was evaluated by a specific implementation of a biopsy assistance navigation software. To simplify navigation, the target slice and needle position were represented in VR, which can be referenced independent from MR-image quality. Synchronization between the tracking-system and the MRI was measured by biopsy simulations (n=100) performed on a phantom. Attempts were carried out by five interventionalists and five untrained probands. Time and hit-rate were compared to reference values [3].

Results

The implemented middleware creates a link between the MRI and the tracking device and reliably aligned the FOV on the puncture needle. No connections were dropped during the experiment. The representation of the image plane and of the current FOV allows a simplified navigation, results in an efficient decrease of procedure time by 22%. The suggested corrections enable also the untrained group to reach a slightly higher hit rate and reduction of interventional time.

Conclusion

The middleware allows the implementation of specific navigation applications without precise knowledge of the underlying manufacturer specific hard- or software. In the experimental setup the middleware allowed the image plane of the dynamic MR-sequence to always show the monitored instrument, guided by the coordinates of a tracking-system.

References

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