Section: **Qualitätssicherung, Workflow, Ergonomie**

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Abstract-Title:
FIRST STEPS TOWARDS IMPARTIAL INTRAOPERATIVE ACCURACY ASSESSMENT IN COMPUTER AIDED SURGERY

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Abstract-Text:
Purpose:
An often mentioned weakness of computer aided surgery and complain of many surgeons is the lack of an exact method for impartial intraoperative error assessment. In absence of such a tool, the most common technique to evaluate the intraoperative error is to point out anatomical landmarks with the navigation probe and estimate the accuracy by visual comparison and gut feeling. Understandably error values are subject to major fluctuation and results underlie the surgeon's subjective estimations. This underlines the need for a more objective technique for such an integral point of utmost importance such as intraoperative accuracy, especially when error values are published in scientific manuscripts. The lack of such a technique prompted us to work on a ways to address algorithms for automated techniques of intraoperative error assessment or registration offset detection.

Method:
Our semiautomatic technique is based on a generation of "point clouds" on a bony surface and subsequent surveying of deviations between each point and surface. With the navigation probe we virtually capture a cloud of 19 points with corresponding coordinates on a planar bony surface, located deeply within the skull base. Under surgical circumstances, this could be the sphenoid sinus anterior wall or the ethmoid sinus skull base for example. Under laboratory circumstances and for accessibility purpose, we chose the pyramid's surface of the petrous bone in our phantom model. The planar surface where the point cloud was captured was roughly one square centimeter in size. In a previous step, the bony surface of the phantom was segmented with a feature of our planning software and afterwards triangulated, so it allows gaining the display of a three-dimensional triangle network.
After each point-cloud generation step, we manually determined the minimal distance between each registered point to the nearest segmented bony surface. This way we obtained a three-dimensional offset for our field of interest. In order to appraise the quality of error values generated by this technique, we compared it to the well established technique of error assessment by fiducial markers. Here 28 fiducial CT-markers were placed along the lateral and the frontal scull base of our model. Overall we performed 50 runs of a "point cloud" acquisition on various field on the skull base. The navigation system used in our experiment was an opto-electric setup (CappaENT, CAS innovations) with automated frame based registration and laboratory tests were performed with a previously

described phantom model.

Results:
With the new method we reached a reproducible absolute deviation of 1.4 mm compared to a deviation of 1.5 mm with the marker based examination. In both methods the maximum deviation was 1.7mm.

Conclusion:
Impartial error assessment, especially while carrying out surgery, has yet to be mastered. No technique exists that allows an accurate and reliable offset detection.
Here we describe an algorithm that has potential to be implemented as quality control into computer aided surgery systems. To determine its feasibility we designed it in a first step as a semiautomatic tool. Therefore manual score of the offsets is still necessary. For an implementation into a surgical system however, a fully automated function is necessary and is focus of our current research towards an impartial intraoperative accuracy assessment in computer aided surgery.