Head-mounted augmented reality surgical navigation

- Super-resolution for localizing electrode grids as small, deformable objects during epilepsy surgery using augmented reality headsets
- Validation Study on Iatrogenic Nerve Damage Reduction Using Augmented Reality on Elbow Phantom
- Near-infrared beacons: tracking anatomy with biocompatible fluorescent dots for mixed reality surgical navigation
- Augmented Reality in Scoliosis Correction Surgery: Efficiency and Accuracy in Pedicle Screw Instrumentation
- Augmented Reality Navigation in Craniomaxillofacial/Head and Neck Surgery
- Depth-based registration of 3D preoperative models to intraoperative patient anatomy using the HoloLens 2
- Augmented reality-guided osteotomies for simulated mandibular reconstruction with fibular bone using virtual cutting guides and 3D navigation
- Augmented reality in cranial surgery: Surgical planning and maximal safety in resection of brain tumors via head-mounted fiber tractography

During the past two decades, head-mounted augmented reality neurosurgical Intraoperative Navigation systems have been increasingly employed in a variety of surgical specialties as a result of both advancements in augmented reality-related technologies and surgeons' desires to overcome some drawbacks inherent to conventional surgical navigation systems. In the present time, most experimental HMARSN systems adopt overlain display (OD) that overlay virtual models and planned routes of surgical tools on corresponding physical tissues, organs, lesions, and so forth, in a surgical field to provide surgeons with an intuitive and direct view to gain better hand-eye coordination as well as avoid attention shift and loss of sight (LOS), among other benefits during procedures. Yet, its system accuracy, which is the most crucial performance indicator of any surgical navigation system, is difficult to ascertain because it is highly subjective and user-dependent. Therefore, this study aimed to review presently available experimental OD HMARSN systems qualitatively, explore how their system accuracy is affected by overlain display, and find out if such systems are suited to large-scale clinical deployment.

Ye et al. searched PubMed and ScienceDirect with the following terms: head-mounted augmented reality surgical navigation, and 445 records were returned in total. After screening and eligibility assessment, 60 papers were finally analyzed. Specifically, we focused on how their accuracies were defined and measured, as well as whether such accuracies are stable in clinical practice and competitive with corresponding commercially available systems.

The primary findings are that the system accuracy of OD HMARSN systems is seriously affected by a transformation between the spaces of the user's eyes and the surgical field because the measurement of the transformation is heavily individualized and user-dependent. Additionally, the transformation itself is potentially subject to changes during surgical procedures and hence unstable. Therefore, OD HMARSN systems are not suitable for large-scale clinical deployment [1].

1)

Ye J, Chen Q, Zhong T, Liu J, Gao H. Is Overlain Display a Right Choice for AR Navigation? A Qualitative Study of Head-Mounted Augmented Reality Surgical Navigation on Accuracy for Large-Scale Clinical Deployment. CNS Neurosci Ther. 2025 Jan;31(1):e70217. doi: 10.1111/cns.70217. PMID: 39817491;

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