A navigation system, often based on infrared or laser technology, is used to track the position of surgical instruments and guide them to the predetermined coordinates within the body.

In neurosurgery, it is important to inspect the spatial correspondence between the preoperative medical image (virtual space), and the intraoperative findings (real space) to improve the safety of the surgery. Navigation systems and related modalities have been reported as methods for matching this correspondence. However, because of the influence of the brain shift accompanying craniotomy, registration accuracy is reduced. In a study, to overcome these issues, Koike et al. developed a spatially accurate registration method of medical fusion 3-dimensional computer graphics and the intraoperative brain surface photograph, and its registration accuracy was measured.

The subjects included 16 patients with glioma. Nonrigid registration using the landmarks and thin-plate spline methods was performed for the fusion 3-dimensional computer graphics and the intraoperative brain surface photograph, termed mixed-reality computer graphics. Regarding the registration accuracy measurement, the target registration error was measured by two neurosurgeons, with 10 points for each case at the midpoint of the landmarks.

The number of target registration error measurement points was 160 in the 16 cases. The target registration error was 0.72 ± 0.04 mm. Aligning the intraoperative brain surface photograph and the fusion 3-dimensional computer graphics required ~10 minutes on average. The average number of landmarks used for alignment was 24.6.

Mixed-reality computer graphics enabled highly precise spatial alignment between the real space and virtual space. Mixed-reality computer graphics have the potential to improve the safety of the surgery by allowing complementary observation of brain surface photographs and fusion 3-dimensional computer graphics [1)].

1)
Koike T, Kin T, Tanaka S, Takeda Y, Uchikawa H, Shiode T, Saito T, Takami H, Takayanagi S, Mukasa A, Oyama H, Saito N. Development of Innovative Neurosurgical Operation Support Method Using Mixed-Reality Computer Graphics. World Neurosurg X. 2021 Mar 13;11:100102. doi: 10.1016/j.wnsx.2021.100102. PMID: 33898969; PMCID: PMC8059082.