

## Publication

### Endoscopic navigation for minimally invasive suturing

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Manipulating small objects such as needles, screws or plates inside the human body during minimally invasive surgery can be very difficult for less experienced surgeons, due to the loss of 3D depth perception. This paper presents an approach for tracking a suturing needle using a standard endoscope. The resulting pose information of the needle is then used to generate artificial 3D cues on the 2D screen to optimally support surgeons during tissue suturing. Additionally, if an external tracking device is provided to report the endoscope's position, the suturing needle can be tracked in a hybrid fashion with sub-millimeter accuracy. Finally, a visual navigation aid can be incorporated, if a 3D surface is intraoperatively reconstructed from video or registered from preoperative imaging.

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