Endoscopic naviagion 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. Classical navigation techniques are often incapable of providing support in such situations, as the augmentation of the scene with the necessary artificial markers–if possible at all–is usually cumbersome and leads to increased invasiveness. We present an approach relying solely on a standard endoscope as a tracking device for determining the pose of such objects, using the example of a suturing needle. The resulting pose information is then used to generate artificial 3D cues on the 2D screen to provide optimal support for surgeons during tissue suturing. In addition, if an external tracking device is provided to report the endoscope's position, the suturing needle can be directly tracked in the world coordinate system. Furthermore, a visual navigation aid can be incorporated if a 3D surface is intraoperatively reconstructed from the endoscopic video stream or registered from preoperative imaging.
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