

Smart Orthopedic Surgery System-Continuous Tracking Surgical Assistance System

MIRDC

Introduction

It is an integrated system including optical 3D composite positioning, a multi-vertebral image navigation system, and a surgical-assisted robotic arm that can position each vertebral segment independently. It can also dynamically track more than three vertebral segments, assisting physicians in providing more accurate safer surgical efficiency

➤ **Optical 3D composite positioning** : The dodecahedron small-sized positioning markers with QR Code identification marks can be positioned at each independent vertebral segment. Through the independent QR Code of each facet of the small-sized positioning markers, the binocular vision positioning camera can take images and calculate its spatial coordinates. Combined with independent vertebral segment images, the surgical posture can be corrected in real-time. Small-sized positioning markers have a diameter of 32mm, 3D positioning $RMS \leq 0.5mm$, synchronous tracking of more than 15 groups of IDs, and an update frequency of $\geq 40Hz$. Compared with the tracking systems used by other major international manufacturers' navigation systems, the occupied space can be greatly reduced by more than 50%.

➤ **Multi-vertebral image navigation system** : Automatic multi-vertebral segment segmentation technology, using deep learning cardinality to enable CT-reconstructed spine stereo images to be segmented into multiple independent vertebral segments and then matched with dodecahedron small-sized positioning markers of each vertebra, which can instantly correct the image information of each vertebral segments to improve positioning accuracy.

➤ **Surgical-assisted robotic arm** : Combining a high-resolution camera with a robotic arm is automatically guided to move to the surgical position through AI intelligent paths, providing physicians with correct instrument trajectories and surgical space between operations, and can correct subtle errors in real-time. After obtaining the compensation displacement, the physician can accurately guide the implant angle and depth.

Awards/Patents

- Applying for domestic and foreign patents for 29 include optical positioning systems, navigation systems, and surgical robotic arm systems, and 14 have been qualified and issued
- 2021 Taiwan Innotech Expo, TIE Award of GOLD
- R&D 100 (2022 Global Top 100 Innovation Award)
- 2022 Red Dot – Product Design

Industrial Applications/ Case Studies

- Orthopedic Surgery Positioning, minimally invasive surgery positioning



Optical 3D composite positioning



dodecahedron six degrees of freedom (6DOF)



Multi-vertebral image navigation system