

DEVELOPMENT OF A SUSTAINABLE, HIGH-PRECISION LIVER RESECTION NAVIGATION SYSTEM USING MACHINE-LEARNING-ENHANCED OBJECT TRACKING AND MARKERLESS AUGMENTED REALITY ON A VIDEO PASS-THROUGH SPATIAL-COMPUTING WEARABLE HEADSET

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Poster

Hepatobiliary

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A markerless augmented-reality navigation system using Apple Vision Pro maintained sub-2 mm accuracy in liver resections while halving intra-operative power consumption compared with conventional 2-D monitors.

KEY POINTS

- The system projects patient-specific 3D anatomy from CT/MRI into a head-mounted display using machine-learning segmentation and LiDAR-based registration without external tracking markers
- In simulator trials with four surgeons, the AR headset improved spatial awareness, reduced mental and temporal workload, and decreased head, neck and shoulder fatigue compared with 2-D monitors
- Power consumption and CO₂ emissions were lower than conventional endoscopic monitors, and eliminating monitor carts, cables, ceiling-mounted arms and sterile drapes reduced single-use waste
- Positional error between holographic overlay and actual organ remained below 2 mm in open, laparoscopic and robotic liver resections, with video pass-through latency under 20 ms
- An ongoing multicentre study is incorporating real-time deformation modelling and automated resection-line prediction with planned expansion across hepatobiliary-pancreatic procedures

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