

ACS 2026 Surgeons and Engineers: A Dialogue on Surgical Simulation

O-04

Research In-Progress

AI-Driven Dual-Layer Surgical Navigation to Prevent Ureteric Injury: Development and Preclinical Validation of DragonFlyX

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Introduction: Ureteric injuries occur in 0.3-2.0% of abdominal and pelvic surgeries, leading to substantial morbidity, including prolonged hospitalization, renal damage, and additional interventions, with costs up to \$250,000 per incident. Our system mitigates this risk through a dual-layer platform: a customized fluorescent ureteric stent integrated with AI software for continuous, real-time ureter visualization, without disrupting operative workflow. Developed by Rutgers University's Department of Surgery and supported by an NIH-based HealthAdvance grant from Rutgers, this system utilizes near-infrared (NIR) imaging and AI to enhance surgical precision in the connected operating room, targeting high-risk colorectal, gynecologic, and urologic procedures.

Methods: Bench optimization refined stent geometry and fluorescent coatings under simulated surgical conditions. Phantom-based Real-Image Feed Testing (RIFT) evaluated AI software performance in detecting ureteric markers within a ureter phantom model replicating laparoscopic visualization. A total of 105 video frames were analyzed using a custom object detection model trained on annotated NIR images, evaluating accuracy, sensitivity, precision, and latency.

Preliminary Results: In RIFT, DragonFlyX achieved ureteric marker identification in 103 of 105 frames (accuracy 98.1%, sensitivity 97.2%, precision 98.0%). The two undetected instances were associated with suboptimal illumination and partial marker occlusion, identifying opportunities for algorithmic optimization. Mean processing latency was 32 ms per frame, supporting real-time intraoperative applicability. See Fig. 1.

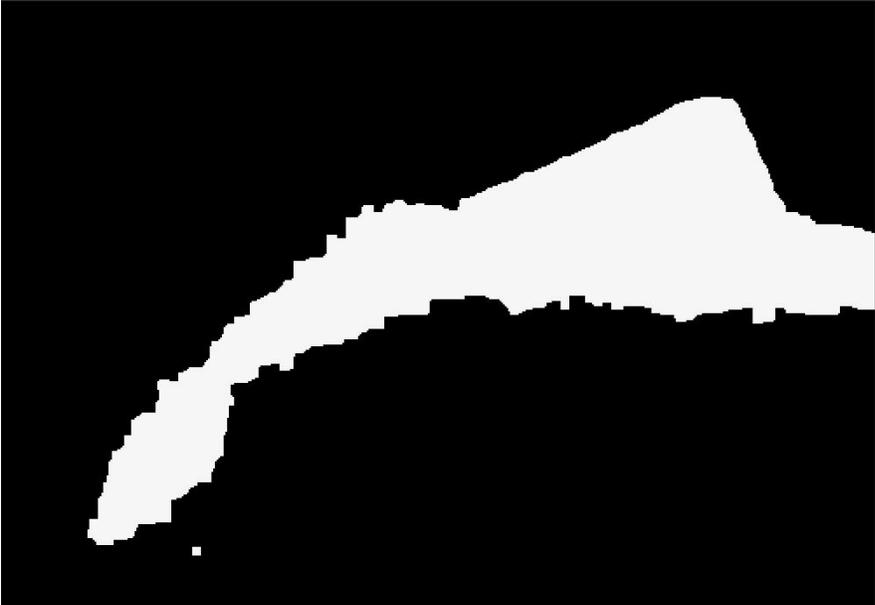
Next Steps: Algorithm refinement will target enhanced robustness to illumination variations and occlusions, aiming for sensitivity exceeding 99%. Subsequent phases include IACUC-approved porcine validation at Rutgers, FDA Q-Submission for regulatory alignment, and IRB-approved first-in-human feasibility studies. These will yield annotated datasets (>10,000 frames) to advance AI capabilities, facilitating multicenter trials.



Detection Info

Distance: 379.50 mm

Object detected



Detection Parameters

Minimum Object Area