ACS 2024 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

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Research Abstracts

Machine Learning Vision System for Measuring Colonoscope Control During Training

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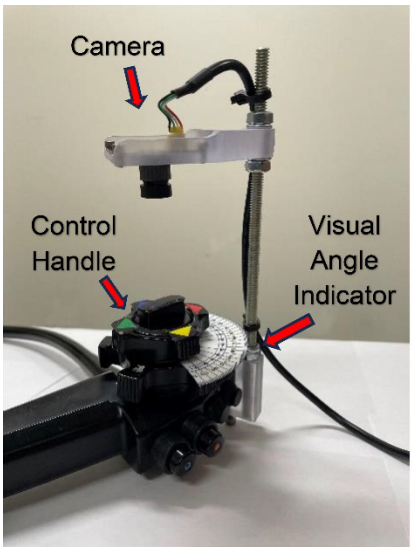
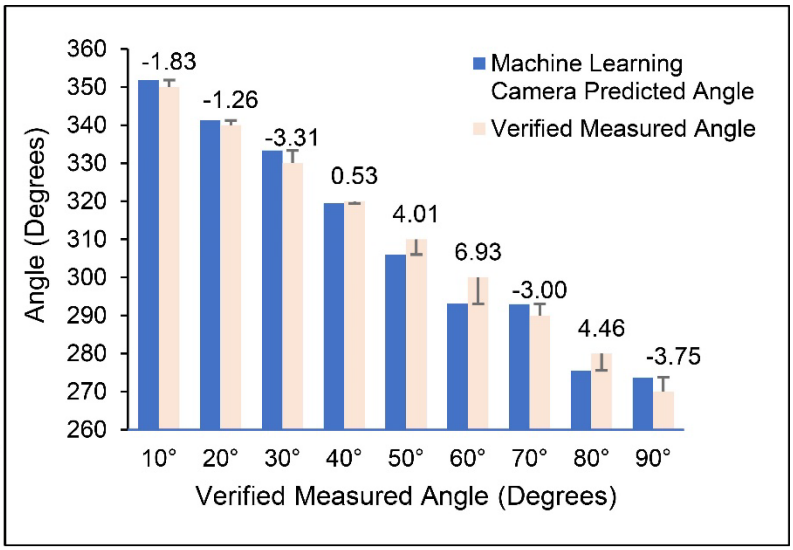
Introduction: Colonoscopy procedures require highly skilled practitioners to successfully maneuver the colonoscope. Manikins offer highly realistic training compared to existing robotic training systems but lack automated learning feedback. To acquire automated feedback during manikin training there must be an effective and accurate system to read users' manipulation of colonoscope control handle position. Therefore, we have developed and validated a machine learning algorithm to accurately measure control handle position.

Methods: A camera mount system attached to the control handle of the colonoscope records the camera measured angle. A machine-learning algorithm analyzes the camera footage to estimate the rotational angles of the control handles. A visual angle indicator attached underneath the handle provides the verified measured angle for the experiment. Experiments are performed in nine trials, in each trial the control handle was rotated an additional 10° from the previous trial (0°-10°, 0°-20°, 0°-30° etc.).

Results: The average angular discrepancy between the experimental camera based measured angle and the physically measured values was 3.2°, with an average percentage error of 1.15%. This shows the ability of the camera based system to effectively measure the angle.

Conclusions: Our system demonstrates an accurate, low-cost, easy to use system to measure users' control handle input during colonoscopy training. The low percentage error in rotational angle measurement will allow this system to be utilized by training software to provide effective user feedback. This would significantly shorten the learning curve for medical residents by providing detailed automated performance feedback. Future work will focus on developing training software that will utilize the users' control handle position information to assess and provide learning feedback to improve colonoscopy performance.


Camera
Control Handle
Visual Angle Indicator


Machine Learning Camera Predicted Angle
Verified Measured Angle
Angle (Degrees)
360
350
340
330
320
310
300
290
280
270
260
-1.83
-1.26
-3.31
0.53
4.01
6.93
-3.00
4.46
-3.75
10°
20°
30°
40°
50°
60°
70°
80°
90°
Verified Measured Angle (Degrees)