

Research Category

PROBLEM / OPPORTUNITY

- Evaluation of surgical performance currently relies on direct observation and feedback, activities that are time-consuming and subject to bias.¹
- Manual analysis of surgical videos can provide objective measures of performance, but even this is prone to subjectivity and error.²
- Valid, reliable and efficient methods of assessing surgical skill are still needed.
- Machine learning technology could provide surgical performance analysis that is both objective and efficient.^{3,4}

IDEA SUMMARY

- We will use an artificial intelligence framework to: 1) objectively measure surgical performance in a database of otologic surgical video clips and 2) provide trainees with quick, objective analytics of videos in near real-time to drive improvement.

VALUE PROPOSITION / BENEFITS



Surgical trainees:

- Receive direct, timely and personalized assessments of skill and performance.



Surgical residency programs:

- Provide efficient, high-quality feedback to trainees and senior surgeons and accurately track progress over time.



Hospital systems:

- Drive quality improvement using attending and trainee surgical performance metrics.

IMPLEMENTATION PLAN

- Define key attributes and steps of a mastoidectomy, a key indicator otologic procedure.
- Develop a computer vision model capable of surgical tool tracking.
- Test and validate the model to ensure accuracy.
- Iteratively teach the model to reliably recognize additional features, such as events and steps.
- Correlate surgical skill level with objective performance measures and define objective benchmarks.
- Apply the model to newly generated trainee surgical videos and provide rapid, objective feedback that can be tracked over time.

RESULTS

Examples of Measures Enabled by Smart Video Review:

- (1) Surgical instrument movement patterns (Figure 1)
- (2) Key surgical steps
- (3) Events and complications

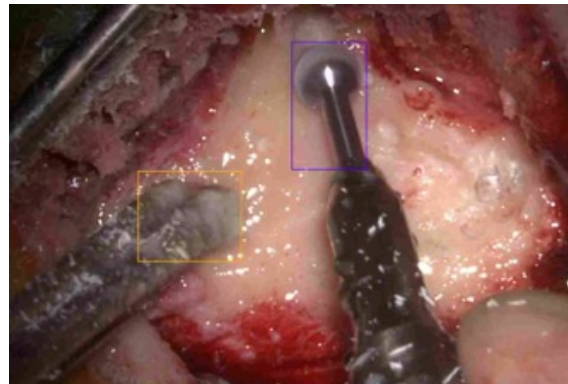


Figure 1. Identification and tracking of instruments during a mastoidectomy using computer vision.

BUDGET / FINANCIALS

- Consultation with machine learning experts for development of the model
- Computer vision and machine learning development education courses
- NVIDIA Jetson platform
- Amazon Web Services Training Environment

LESSONS LEARNED

- Otologic videos are challenging to label because of microscope lens clouding, off-centered recording and frequent instrument and surgeon changes. Accurate machine learning models require high-quality videos.
- Complications of otologic surgery can be devastating and therefore occur very rarely, even for trainees. Objective analysis is not expected to improve rates of complications significantly.
- Instrument tracking alone cannot be used to determine a surgeon's skill level.

REFERENCES

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