PHASE RECOGNITION IN INGUINAL HERNIORRHAPHY - AN OUTSOURCED COMPETITIVE MODEL FOR AI IMPLEMENTATION.

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Background:

- Automated surgical phase recognition can be achieved with AI field called computer vision (CV) and put to use for proficiency and workflow analysis.
- Creation of a CV algorithm depends on video acquisition, annotation, and algorithm training and validation. A difficulty is bringing together the expertise for both manual video review (surgical experience) and CV model creation (computer engineering).
- In a new collaboration for research on surgical video, we proposed an approach for competitively outsourcing the engineering component of CV projects.
- A masters-level class of engineering students was tasked with creating a CV algorithm for phase recognition of robotically assisted laparoscopic inguinal herniorrhaphy (RALIHR).

Methods:

- Recordings of 130 RALIHR videos from a large tertiary referral center.
- Phases labeled by surgical team in collaboration with engineering team.
- Students tasked with optimizing the recognition algorithm as a class assignment using the Kaggle platform.
- Macro F1 Score – measure of the overall accuracy of the model compared to ground truth (manual video review)

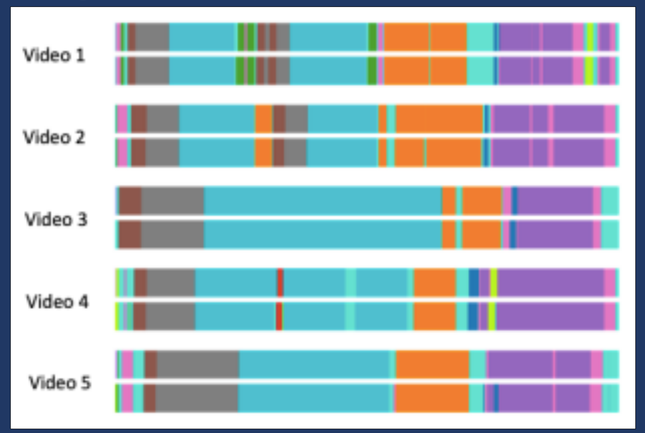


Figure 1

Results

- 130 videos (70 training / 60 test) → labelled with 16 surgical phases
- 12 groups of 2-3 students: two produced F1 score > 80% [Table 1]. Performance of winning model for five videos compared (top) with ground truth (bottom); different colors represent discrete predicted and actual phases [Figure 1].
- The three highest-performing groups used TMRNet as their base model.

Conclusions: Competitive approach to CV model creation amongst engineering students is feasible and early results compare to published CV models produced by experienced engineers (Macro F1 Scores > 0.8).

Table 1: Performance of Top 3 Groups in Descending Rank Order

Group	Macro F1 Score	Model Name	Basis	Style	Size of model (Mb)	Time for training
1	0.82467	TMRNet	SV-RCnet	Recurrent conv net + LSTM	241	3h
2	0.81564	TMRnet	SV-RCnet	Recurrent conv net + LSTM	14256	---
3	0.79971	TMRnet	SV-RCnet	Recurrent conv net + LSTM	137	4h

Table 1

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