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EP116: Developing a Deep Learning Model for Scene Interpretation in Total Laparoscopic Hysterectomy Using a Small Video Dataset

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Introduction

Automatic surgical phase recognition [1] is beneficial in
1. Surgical reviewing
2. Objective surgery evaluation
3. **Reduction of surgeon burden**

Objectives

Develop a practically useful surgical phase recognition deep-learning model with
1. Pre-trained foundational encoder
2. Small dataset
3. PoC with total laparoscopic hysterectomy (TLH)

Material & Methods

Dataset

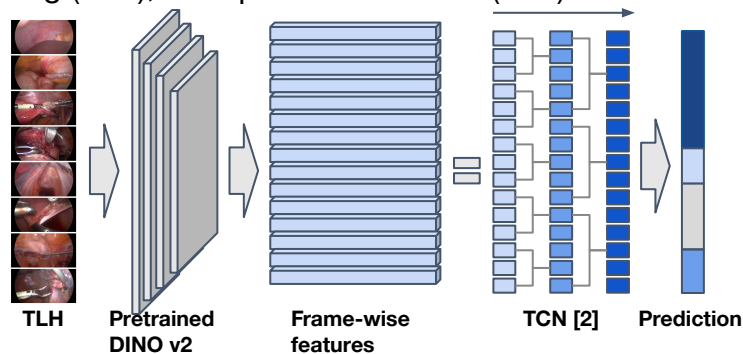41 TLH videos from Inselspital. 25 for training (Train), 7 for tuning (Eval), 9 for performance test (Test).

TLH | Pretrained DINO v2 | Frame-wise features | TCN [2] | Prediction

Fig. 1 Overview of the training

Results

Label Distribution

Train (25 videos) | Eval (7 videos) | Test (9 videos)

Preparation
Adhesiolysis, dissection and mobilization
Colpotomy
Specimen removal
Wasing and hemostasis
Vaginal vault closure
Other
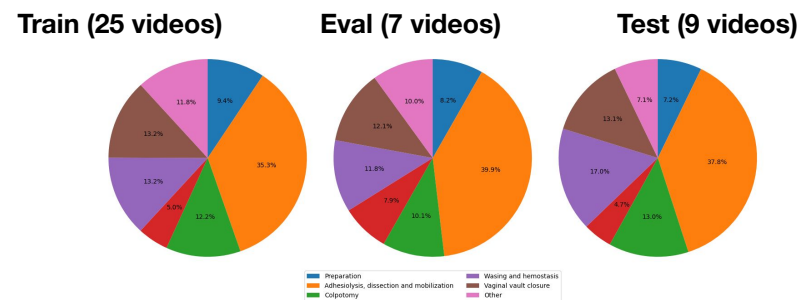
Fig. 2 Frame-wise label distribution in train, eval and test dataset

Model Performance

a) Confusion matrix of the labels
b) AUROC curves for each label
c) One phase-recognition example
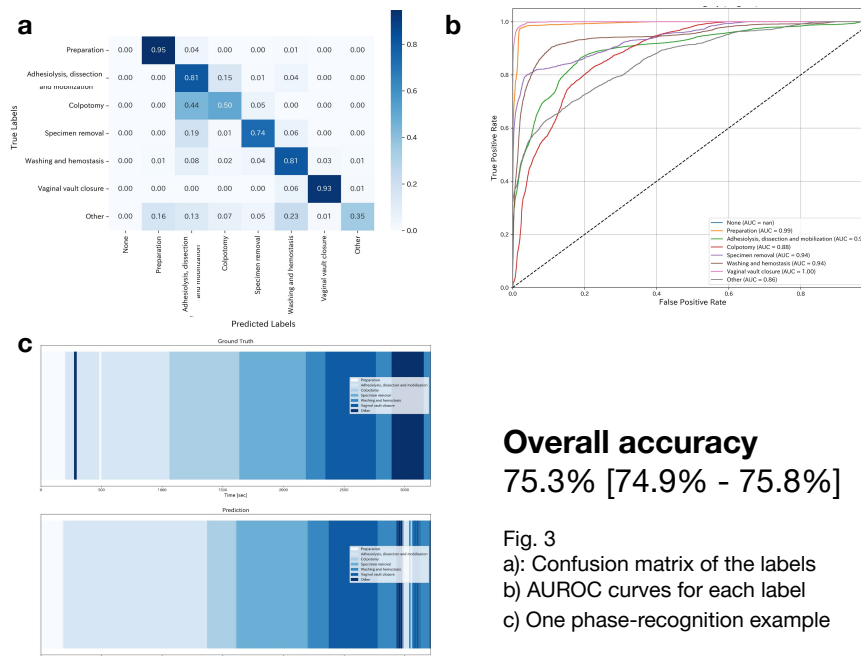
Fig. 3

Overall accuracy

75.3% [74.9% - 75.8%]

Discussion & Conclusion

1. Developed a deep learning model for scene understanding in TLH using a small dataset.
2. Demonstrated promising performance despite limited data.
3. Broader range of temporal features will enhance the model performance

Future work

1. a flexible model applied to other surgeries and label composition with the expanding dataset in Medical Dataway
2. Human-in-the-loop approach so that surgeons' feedback will enhance the model performance

References

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2. Lea, C., Vidal, R., Reiter, A., & Hager, G. D. (2016). Temporal convolutional networks: A unified approach to action segmentation. In Computer Vision–ECCV 2016 Workshops: Amsterdam, The Netherlands, October 8-10 and 15-16, 2016, Proceedings, Part III 14 (pp. 47-54). Springer International Publishing.