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Accurate Detection of Out of Body Segments In Surgical Videos using Semi-Supervised Learning

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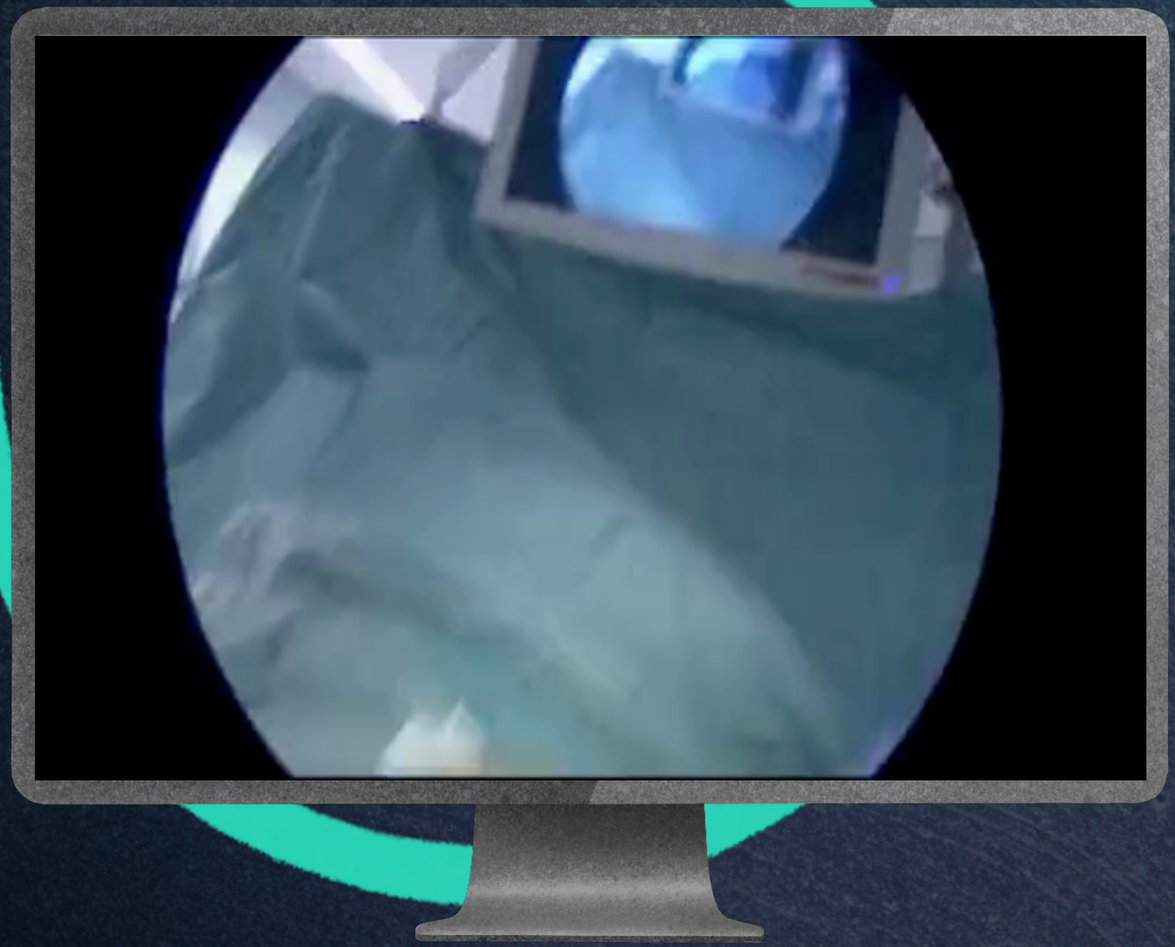
Introduction

Laparoscopic surgery

and *Surgical Intelligence*



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Motivation

- Anonymization
- Reduce storage size
- Enhance model performance

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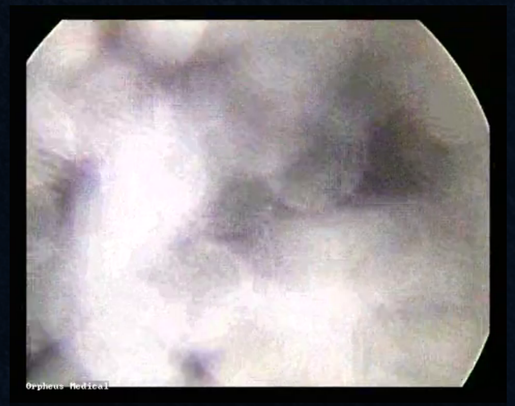
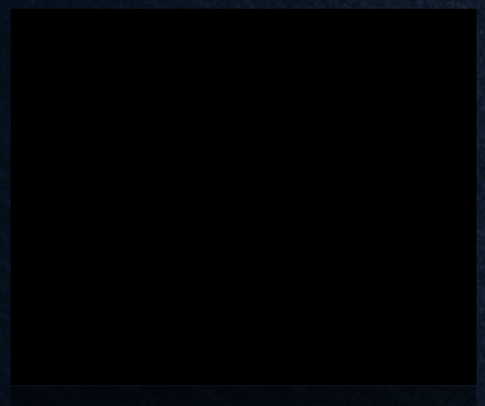
Motivation

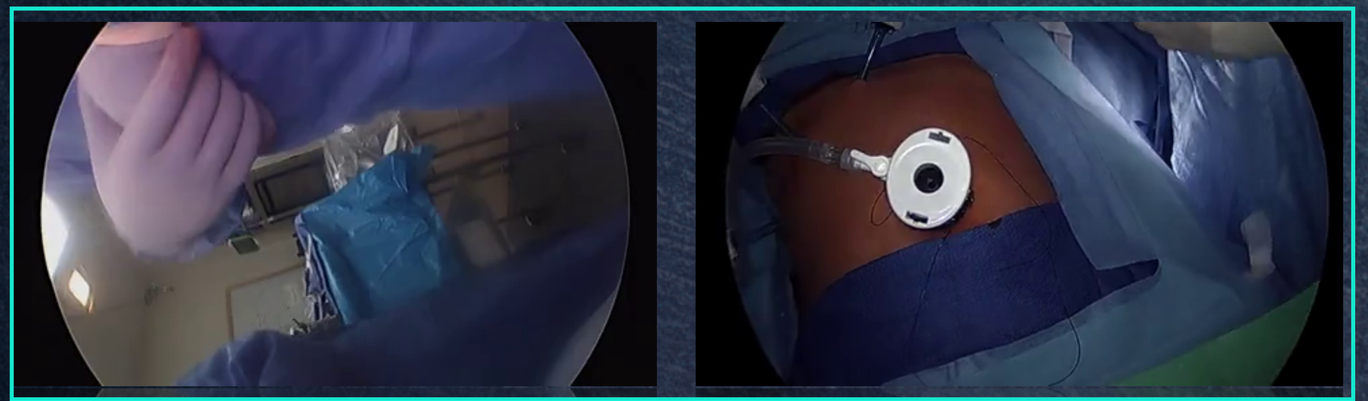
Irrelevant frames and **out of body** segments



Blurred



Dark



Out-of-body

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Our goal

Train a model capable of accurately detecting irrelevant segments throughout an entire surgical video

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Quite simple task for a supervised classification...

But what if the data is only partially labeled?

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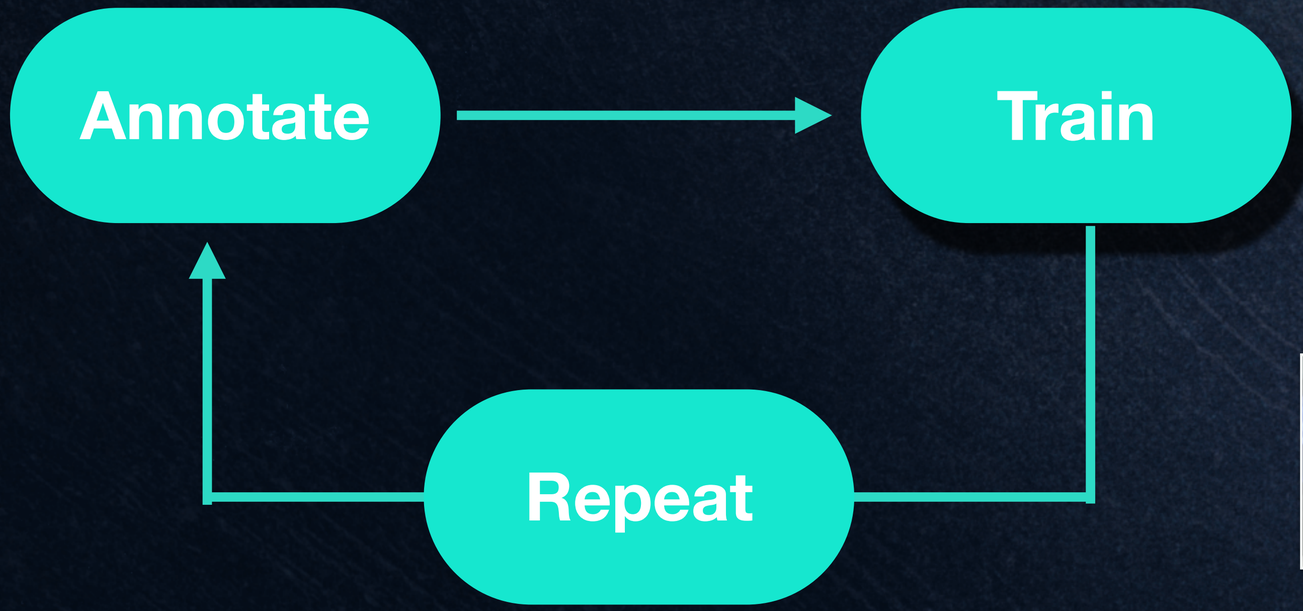
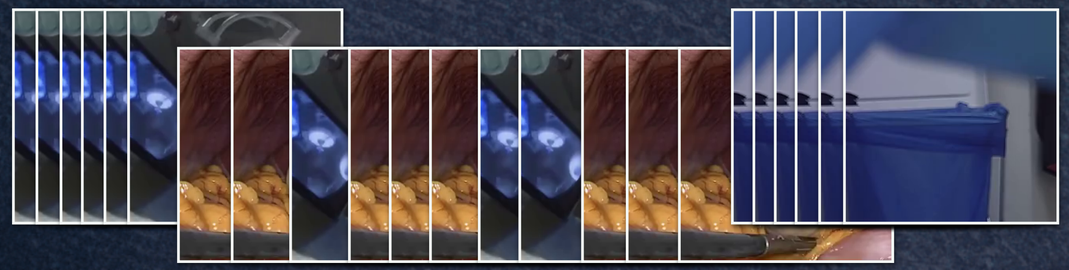
Method



Iteration 0



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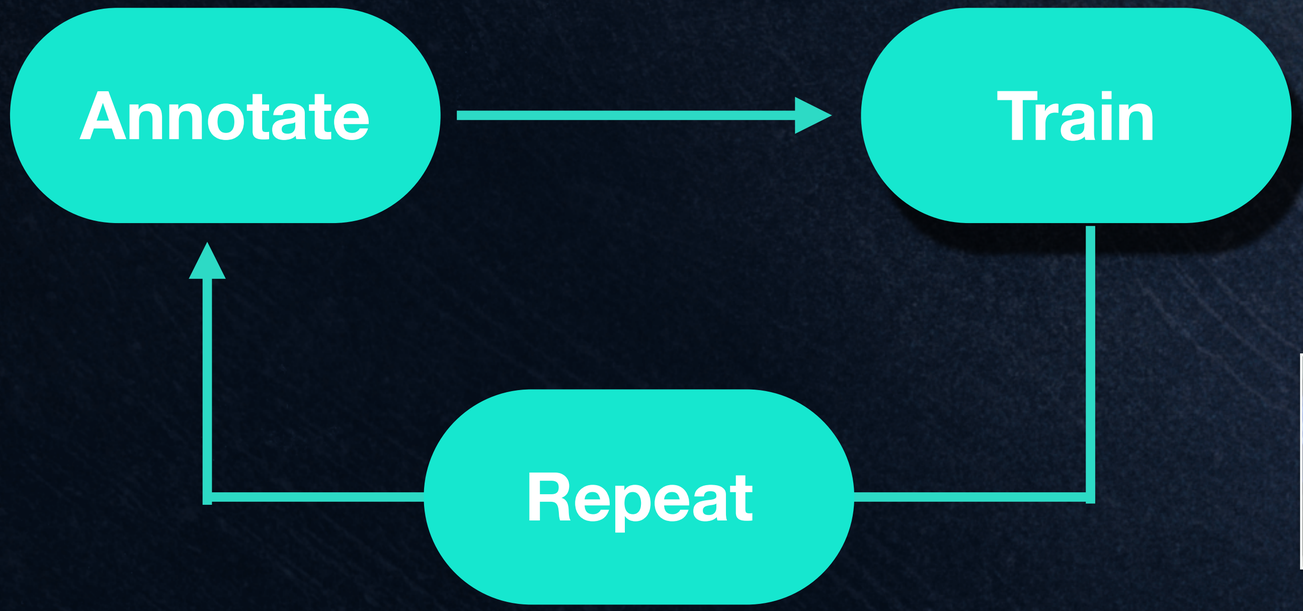
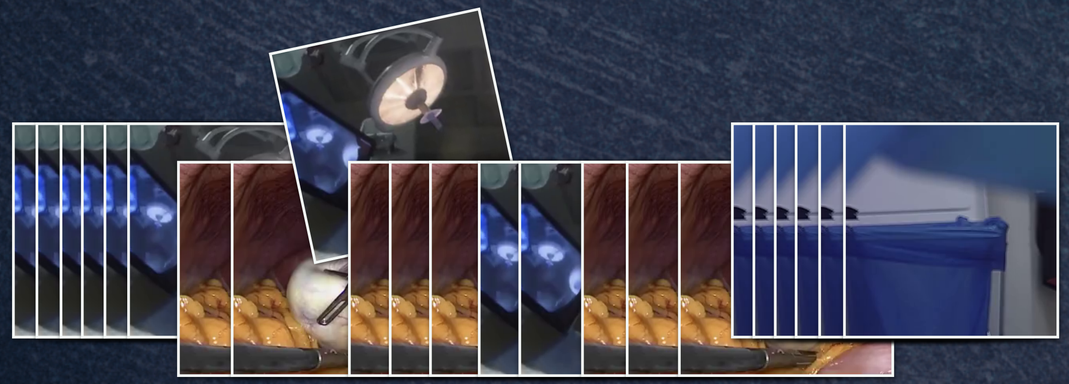
Method



Iteration 1



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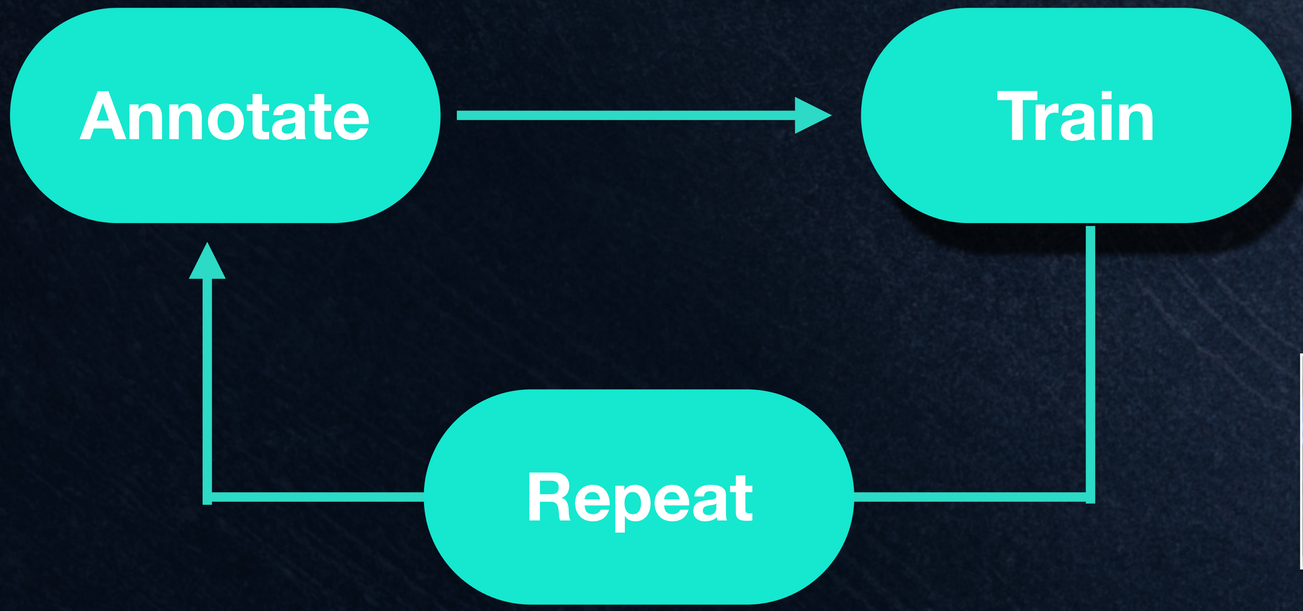
Method



Iteration 2

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Dataset

640 videos

From **6** different medical centers

Partially annotated

Fully annotated

Fully annotated

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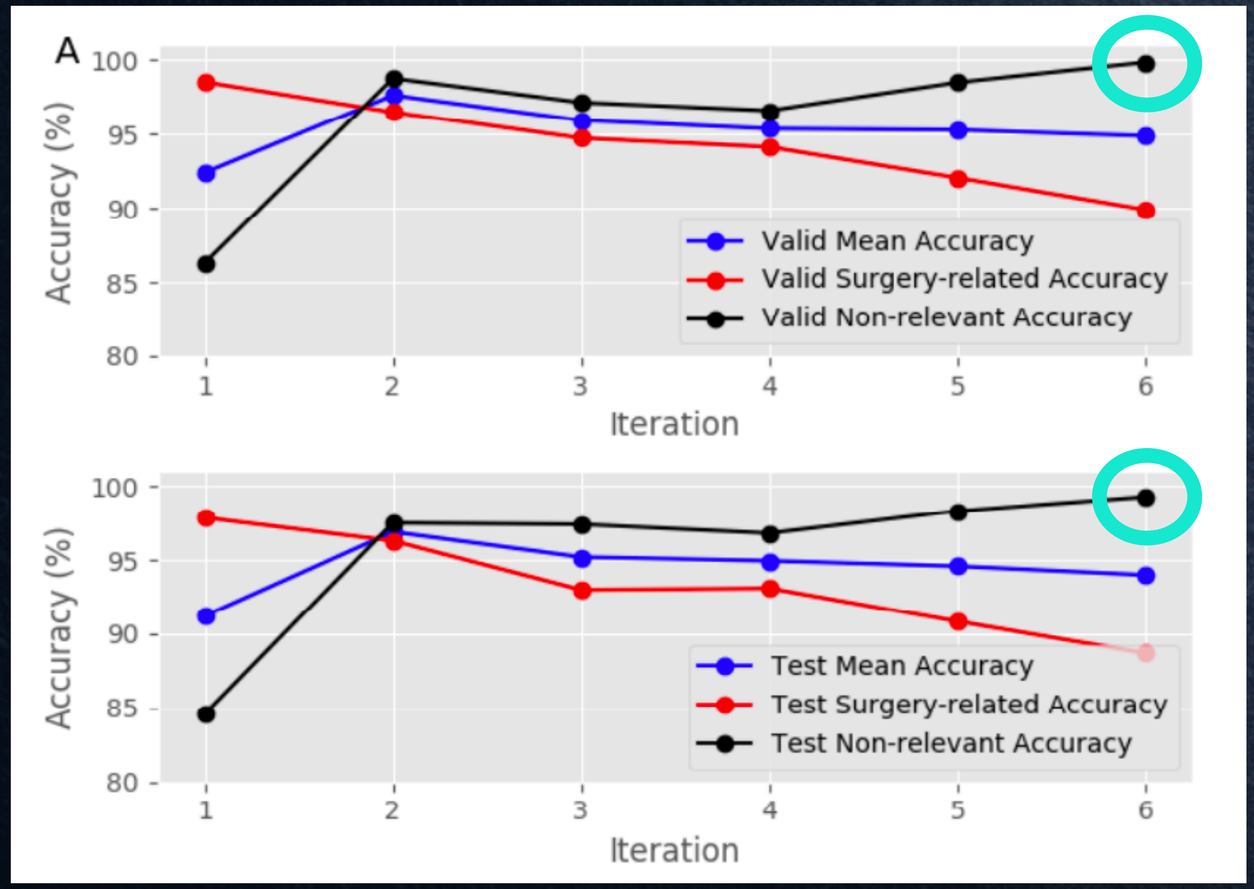
Results



Out-of-body accuracy -

99.85%

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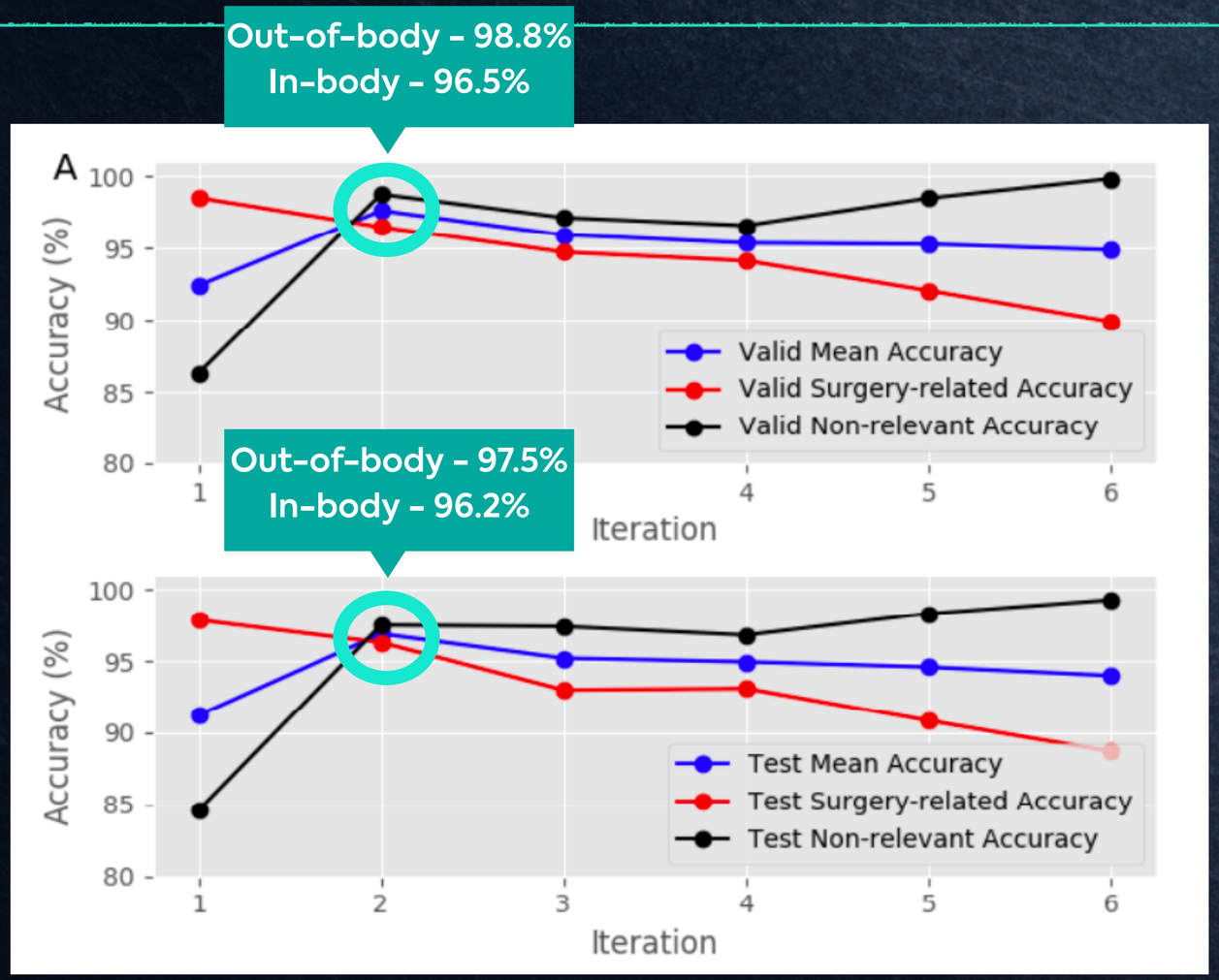
Results



97% Recall @

83.5% Precision

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Results

Twinanda et al., 2014 *	Theator, 2020
56.4% Recall @	**97%** Recall @
30.5% Precision	**83.5%** Precision

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** Andru Putra Twinanda, Michel De Mathelin, and Nicolas Padoy. Fisher kernel based task boundary retrieval in laparoscopic database with single video query. In International conference on medical image computing and computer-assisted intervention, pages 409– 416. Springer, 2014b.*

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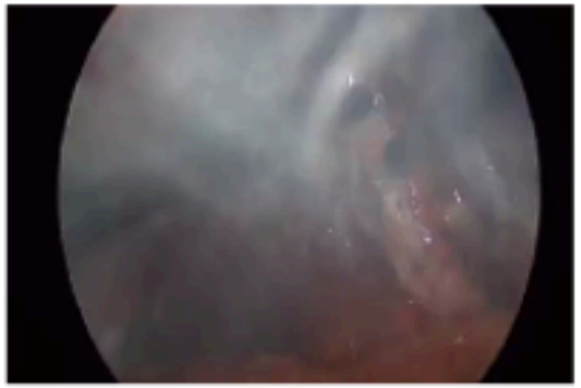
Results

Accurate Predictions

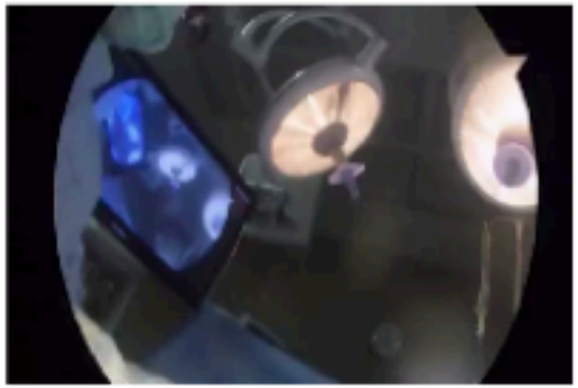
relevant

1.00 relevant
0.00 non-relevant



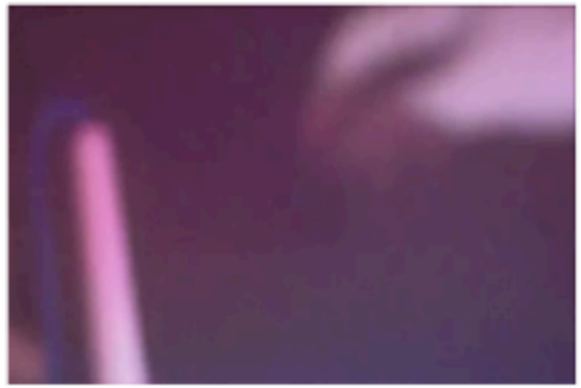
relevant

0.93 relevant
0.07 non-relevant



non-relevant

0.00 relevant
1.00 non-relevant



non-relevant

0.09 relevant
0.91 non-relevant

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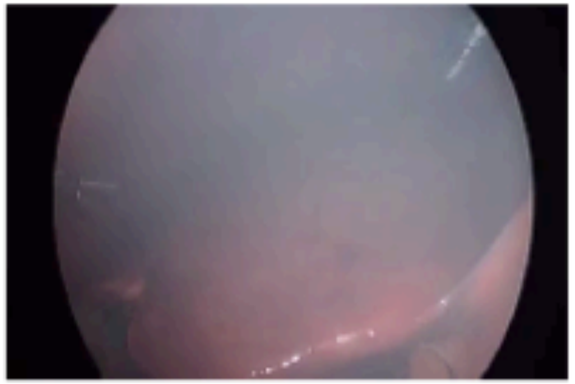
Results

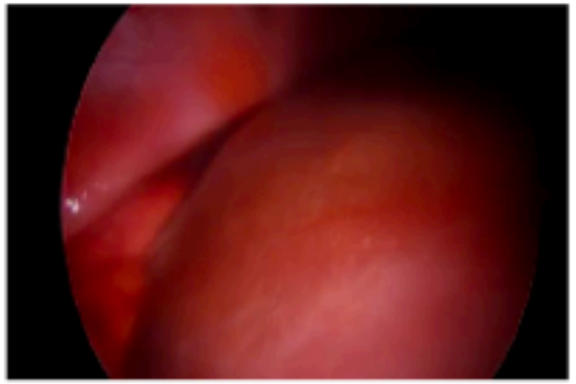
Examples of

Misclassification



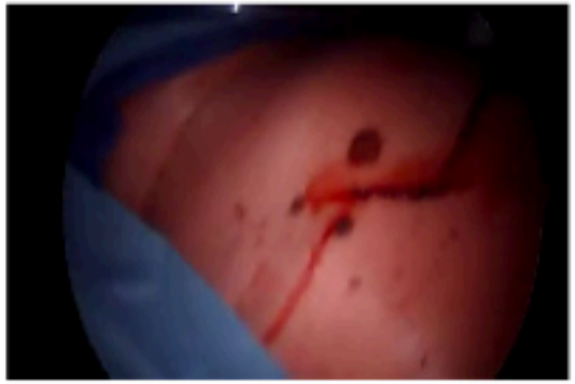
relevant

0.19 relevant
0.81 non-relevant



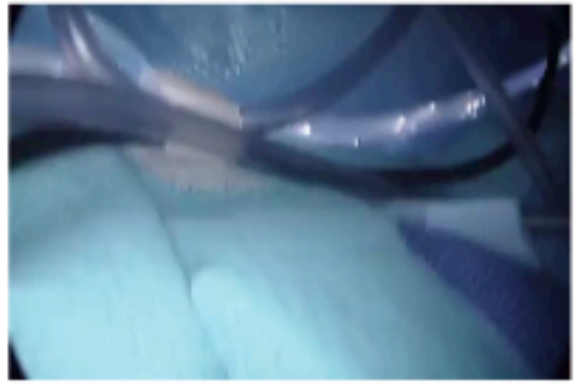
relevant

0.50 relevant
0.50 non-relevant



non-relevant

0.85 relevant
0.15 non-relevant



non-relevant

0.87 relevant
0.13 non-relevant

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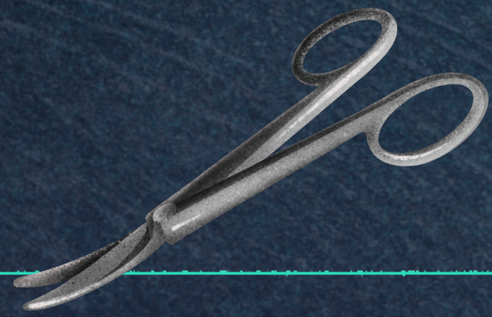
Conclusions



Highly accurate classification of out of body frames

Limitations - handling edge cases

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Thank you!


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