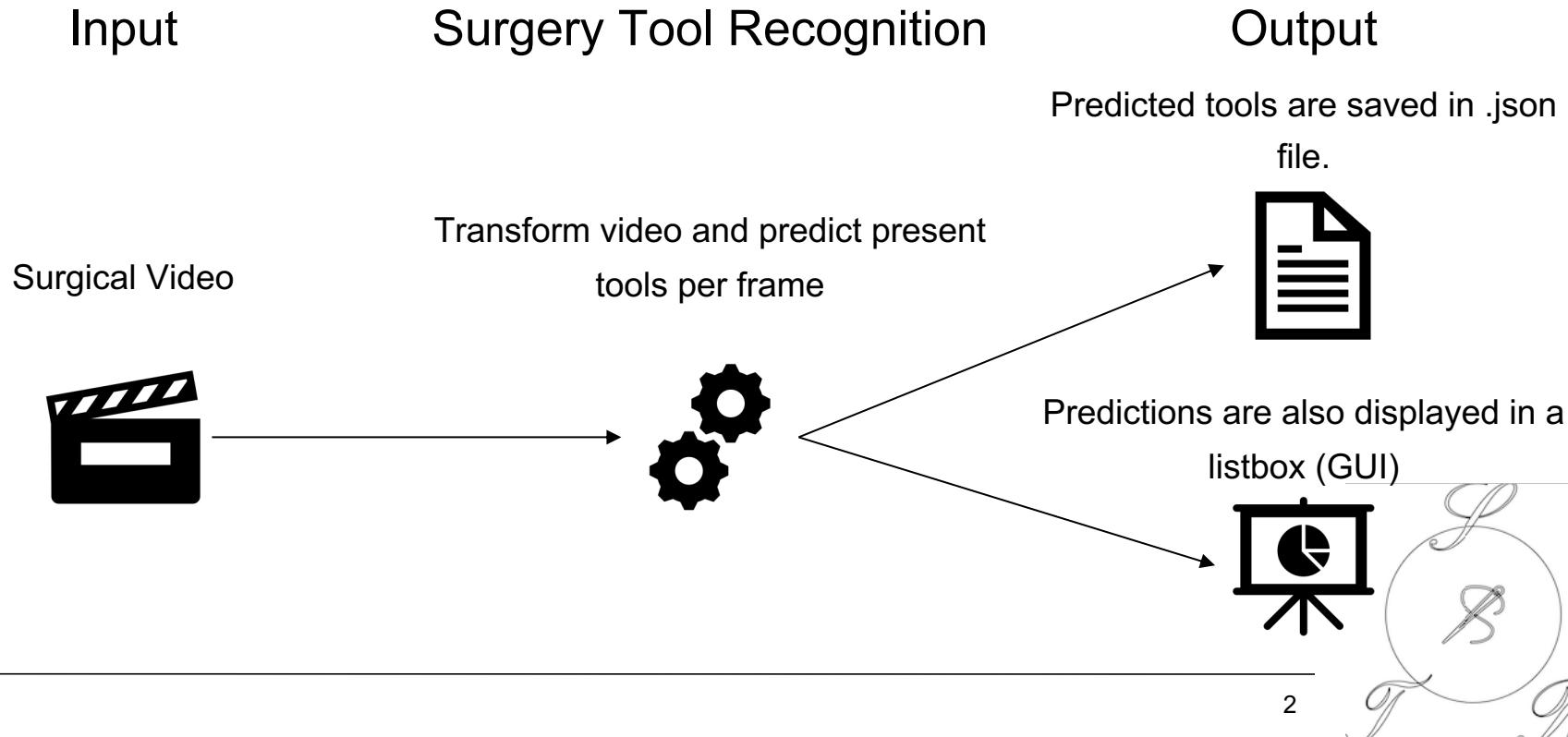


CAI Classification – Surgery Tool Recognition

Nil Crespo-Peiró, Paco Rahn, Amin Ranem



Introduction





DATASET



Cholec80 Dataset

- Contains footage of 80 surgical operations at 25 fps each
- 7 different tools used (Grasper, Bipolar, Hook, Clipper, Scissors, Irrigator, Specimen Bag)



Grasper



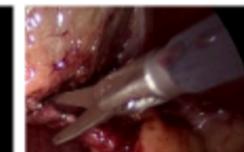
Bipolar



Hook



Clipper



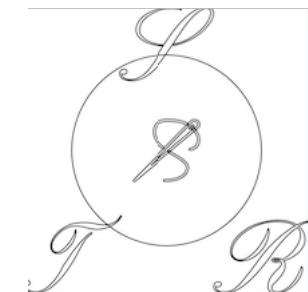
Scissors



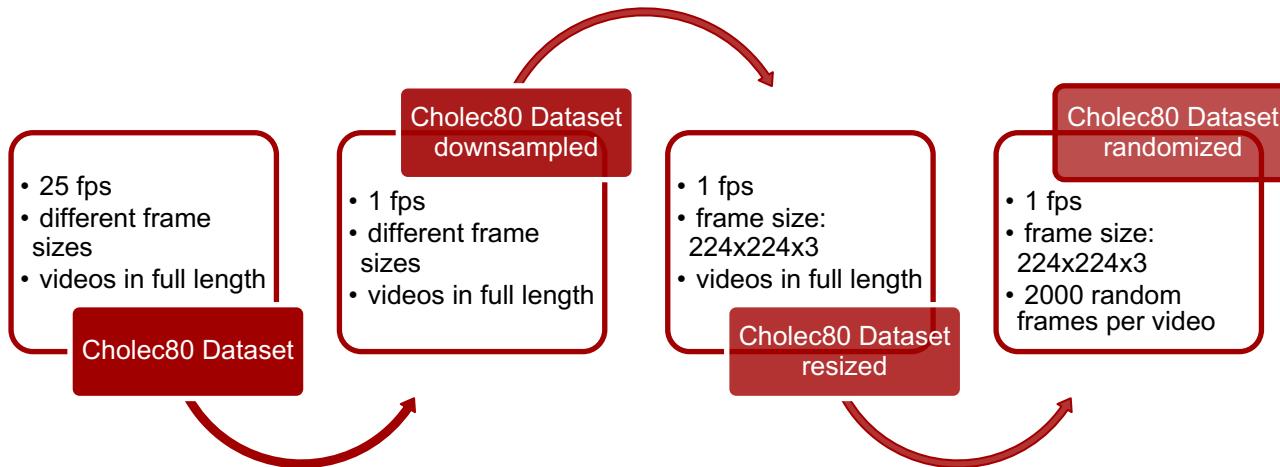
Irrigator



Specimen bag

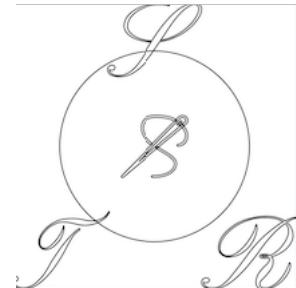


Cholec80 Dataset Preprocessing





MODELS



Models: Structure

ResNet:

- Transfer learning using pre-trained ResNet50 model (PyTorch) by changing the number of output features from the last layer to 7 (number of tools).
- Idea based on the Cholecystectomy Cataract lecture from the Deep Learning for Medical Imaging (DLMI) course where the ZIB-Net was introduced.

AlexNet (ToolNet):

- Transfer learning using pre-trained AlexNet model (PyTorch) by changing the number of output features from the last layer to 7 (number of tools).
- Idea based on official [Paper](#) (EndoNet -- ToolNet to detect tools in a surgical video)



Models: Configuration

ResNet:

- input_shape: (224, 224, 3)
- lr: 0.001
- weight_decay: 0.00005
- batch_size: 62
- nr_epochs: 40 (stopped at 25 → bad results)
- random_frames: True
- nr_video: 80
- nr_frames: 2000
- val_ratio: 0.2
- test_ratio: 0.3

AlexNet (ToolNet):

- input_shape: (224, 224, 3)
- lr: 0.0001
- weight_decay: 0.001
- batch_size: 32
- nr_epochs: 40
- random_frames: True
- nr_video: 80
- nr_frames: 2000
- val_ratio: 0.2
- test_ratio: 0.3



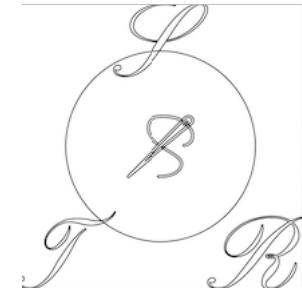
Models: Results

ResNet:

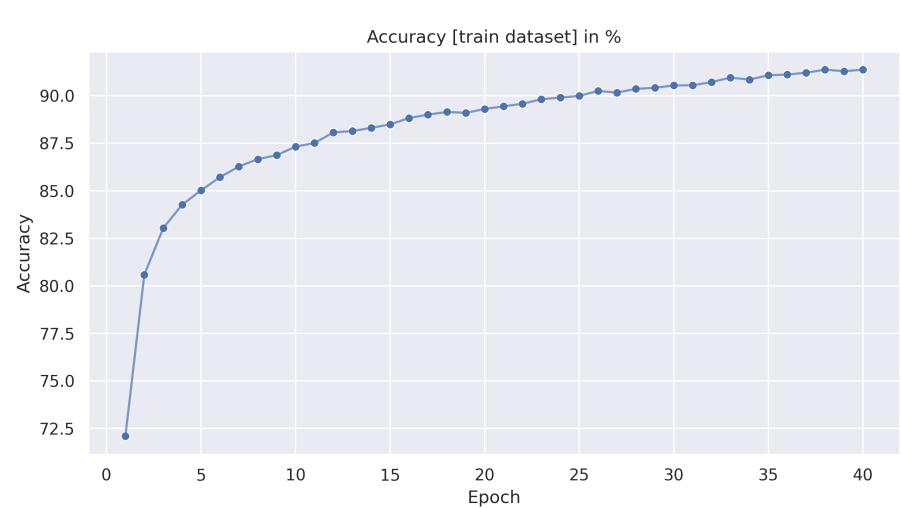
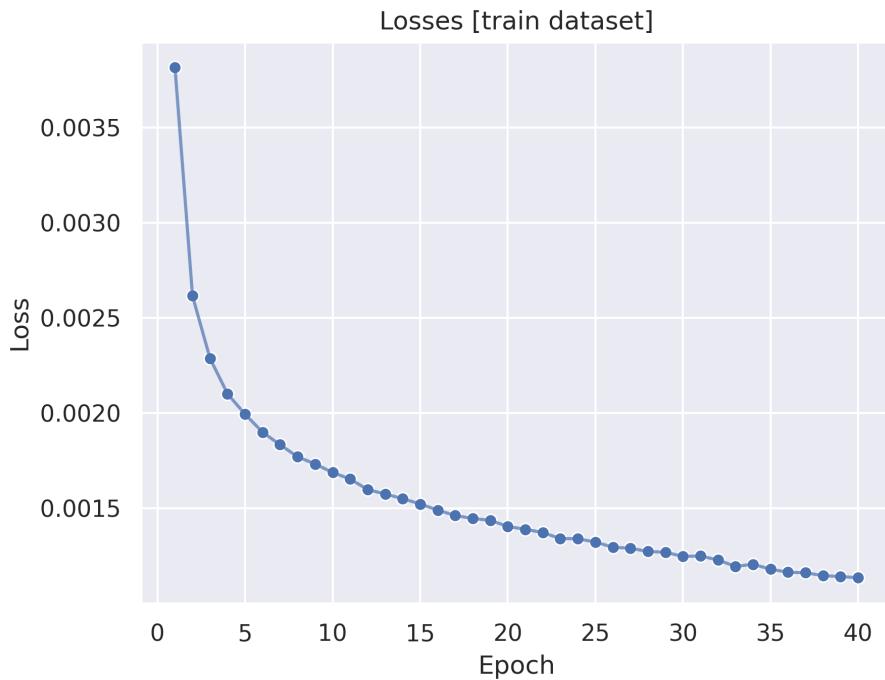
- Training of this approach has been stopped, since the training and validation accuracies were not as promised, although model overfitted on small dataset (see reports):
 - Epoch 10:
 - `train_acc = 30.37%`
 - `val_acc = 30.96%`
 - Epoch 20:
 - `train_acc = 30.37%`
 - `val_acc = 30.97%`

AlexNet (ToolNet):

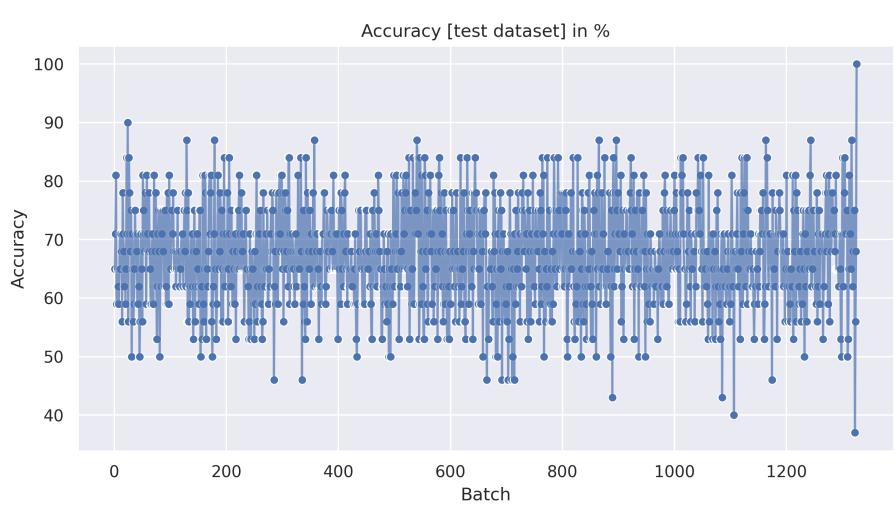
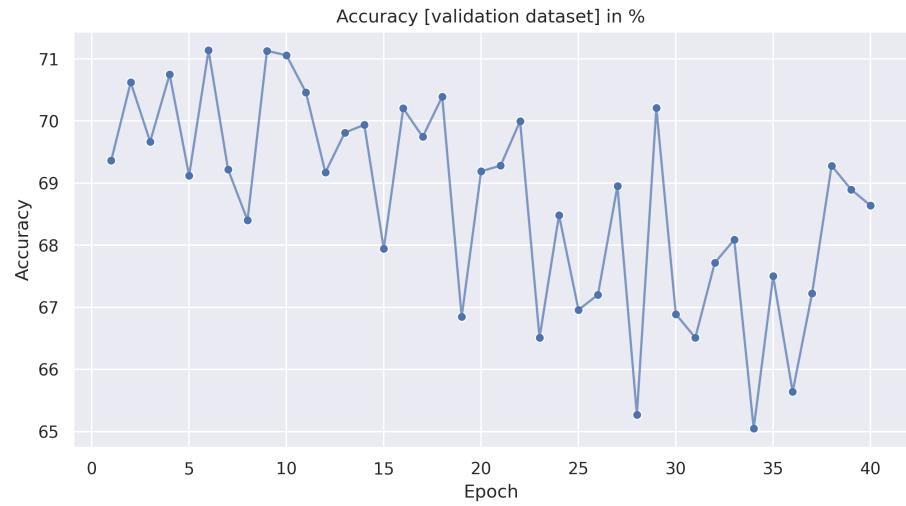
- Training after 40 epochs resulted in an averaged (test) accuracy of 67%
- See corresponding plots on following slide



Models: Results (AlexNet)

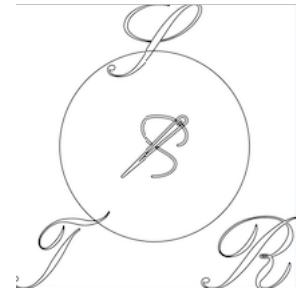


Models: Results (AlexNet)



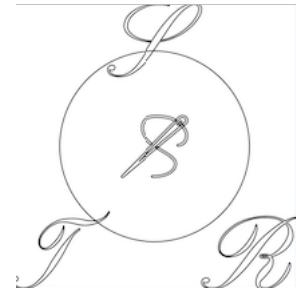


GRAPHICAL USER INTERFACE



Graphical User Interface: Demo Video

Used for making predictions with our pre-trained models

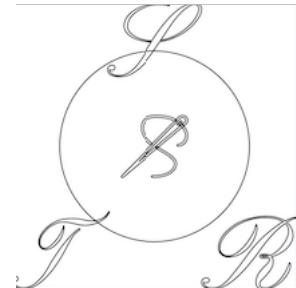
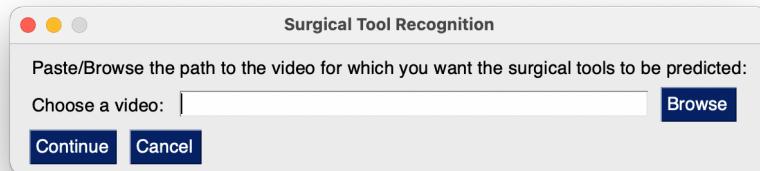


Graphical User Interface: WelcomeWindow

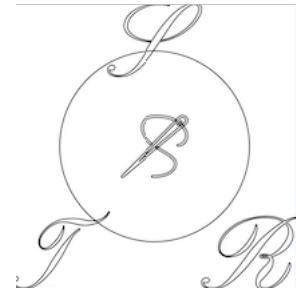
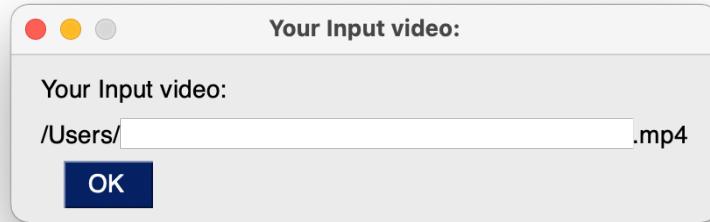


Graphical User Interface: StartWindow

- User needs to specify path to desired video he/she wants to use

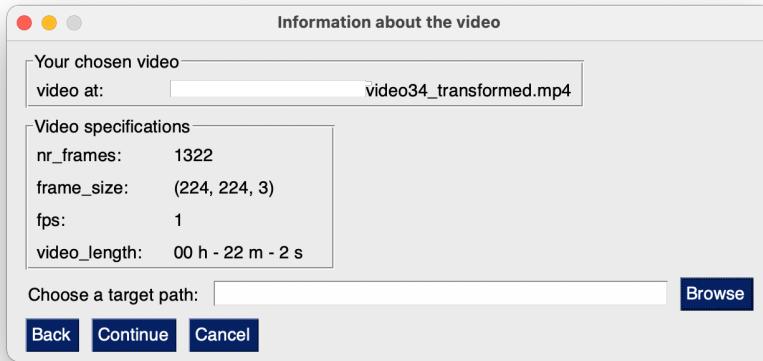


Graphical User Interface: ConfirmationPopUp

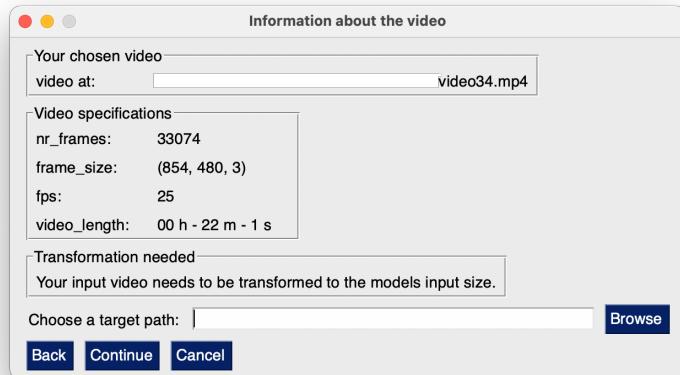


Graphical User Interface: TransformVideo

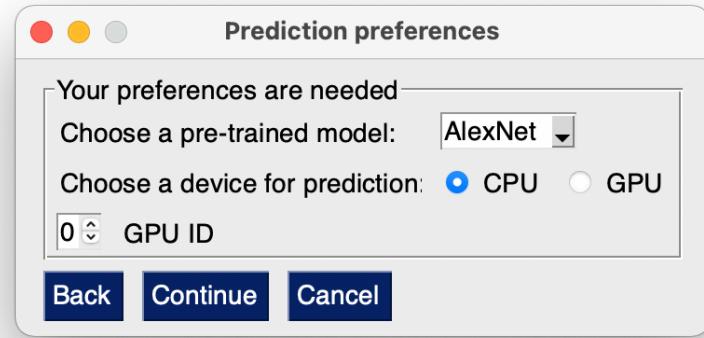
- Video is in desired format



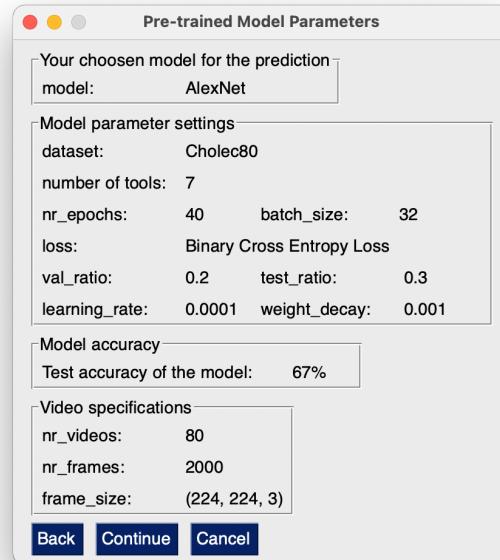
- Video needs to be transformed



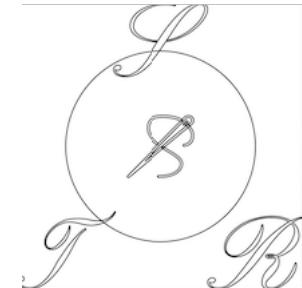
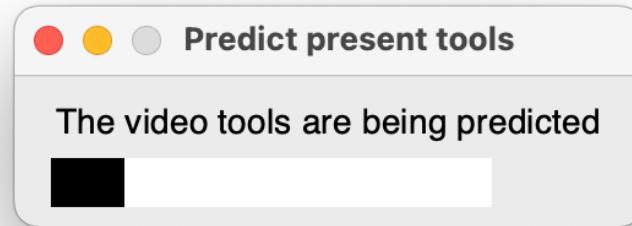
Graphical User Interface: ChooseModelAndDevice



Graphical User Interface: ModelSpecs



Graphical User Interface: PredictVideoTools



Graphical User Interface: ResultWindow

