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Endometriosis detection on ultrasound videos

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Motivation

- Endometriosis is a condition in which cells similar to the lining of the uterus, or endometrium, grow outside the uterus.
- Endometriosis affects an estimated 5%-10% of women and adolescent girls of reproductive age (15-49 years) and up to 50% of infertile women.
- It is a chronic disease associated with severe, life-impacting pain during periods, sexual intercourse, bowel movements and/or urination, chronic pelvic pain, abdominal bloating, nausea, fatigue, and sometimes depression, anxiety, and infertility.
- A definitive diagnosis is made through laparoscopy and biopsy, both of which are highly invasive and expensive.
- An ultrasound can identify large clumps of tissue as potential endometriosis lesions.

The goal

We aim to create a model that can identify potential endometriosis lesions on the rectum using ultrasound videos. This model will assist medical personnel – including general practitioners, midwives, radiologists, and gynecologists – in identifying a possible cause of severe pelvic pain in women.

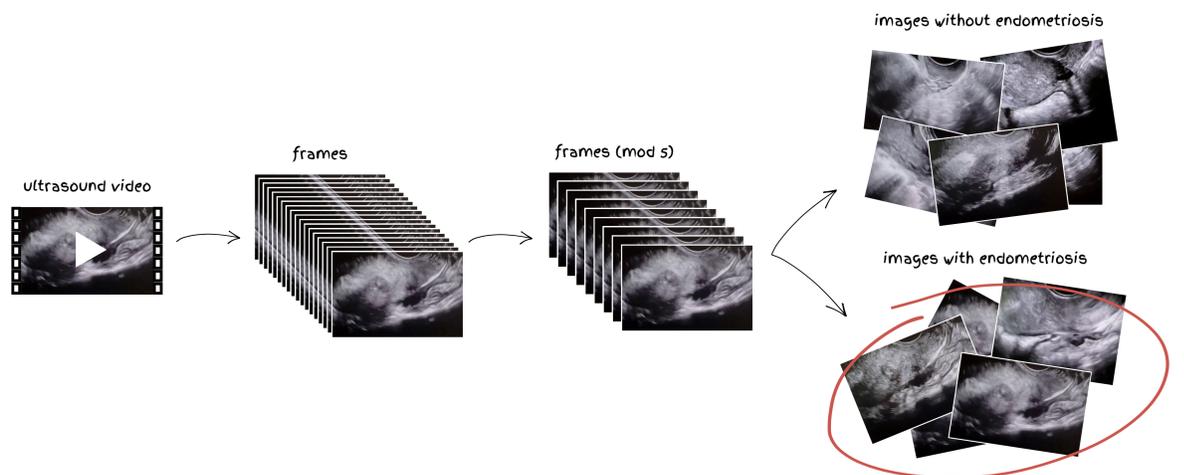
Data description

The data was collected by Dr. Martine Valiere, a specialist in gynecological medical imaging.

- 17 ultrasound videos of uterus and rectum.
- The length of each video is 10-18 seconds.



Data preprocessing



Methods

The model

YOLO v8n (from ultralytics)

- image size = (640, 640, 3)
- optimizer AdamW
- learning rate = 0.002
- momentum = 0.9
- number of epochs = 100
- confidence threshold = 0.7

Training process

We use a cross-validation technique to train and evaluate the models.

For each video, we repeat the following steps:

- Use all frames from the selected video as the test set.
- Shuffle the frames from the remaining videos and split them into a training set (80%) and a validation set (20%).
- Train and evaluate the model. Save the results.

Finally, we compute the average value for each metric.

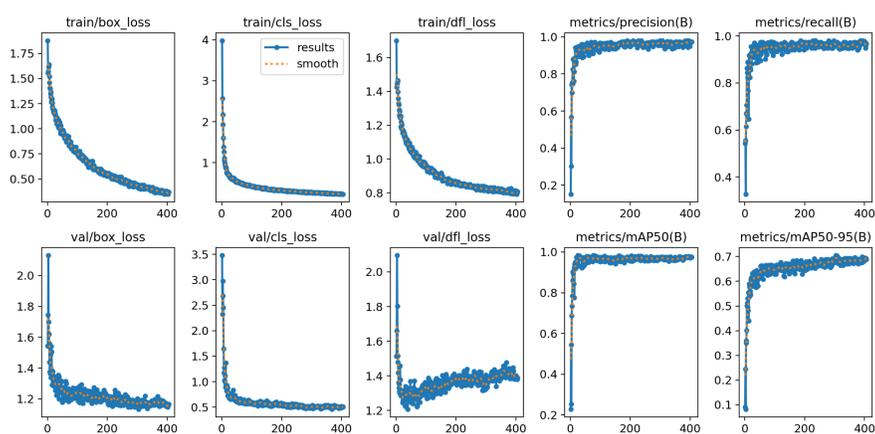
Data augmentation

- hue, saturation, value = 0.015, 0.7, 0.4
- translate = 0.1 (fraction of the image size)
- scale = 0.5
- erasing = 0.4 (probability)

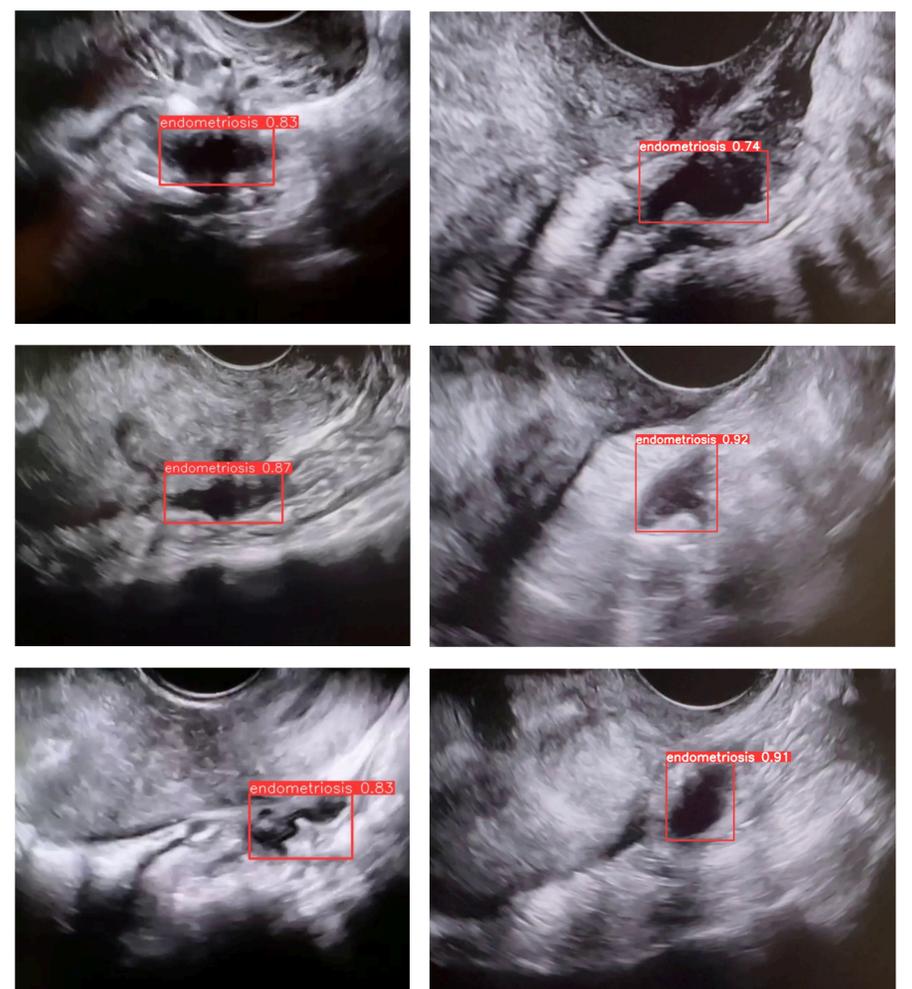
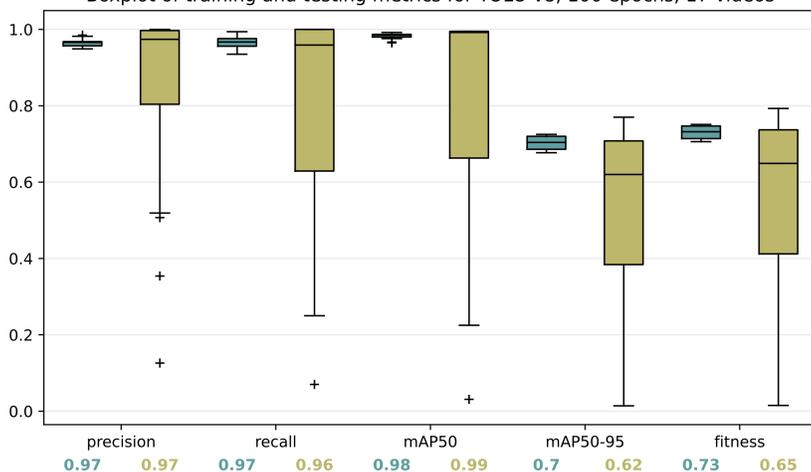
Metrics

- precision**: the proportion of true positives among all positive predictions
- recall**: the proportion of true positives among all actual positives
- mAP50**: computes the area under the precision-recall curve across multiple classes, calculated at an intersection over union threshold of 50%
- mAP50-95**: the average of the mean average precision calculated at varying IoU thresholds, ranging from 50% to 95%
- fitness** = 0.1 · mAP50 + 0.9 · mAP50-95

Results



Boxplot of training and testing metrics for YOLO v8, 100 epochs, 17 videos



References

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[3] Pravin Kumar Samanta, Aadiptya Basuli, Nirmal Kumar Rout, and Ganapati Panda. Improved breast cancer detection from ultrasound images using yolov8 model. In *2023 IEEE 3rd International Conference on Applied Electromagnetics*, pp. 1–6, 2023.