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.

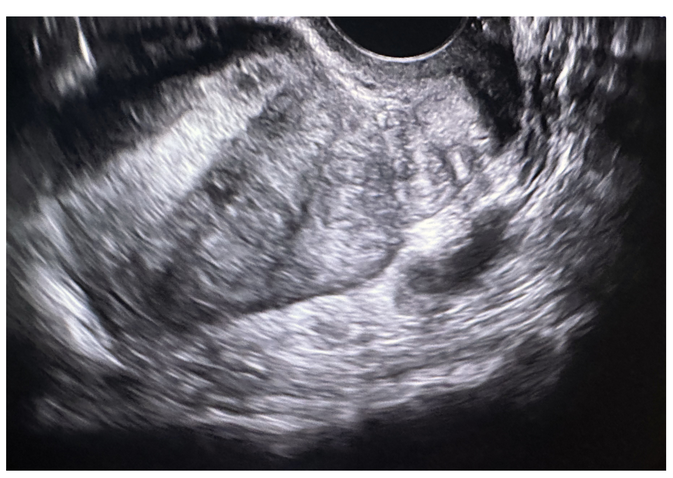
The goal

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.

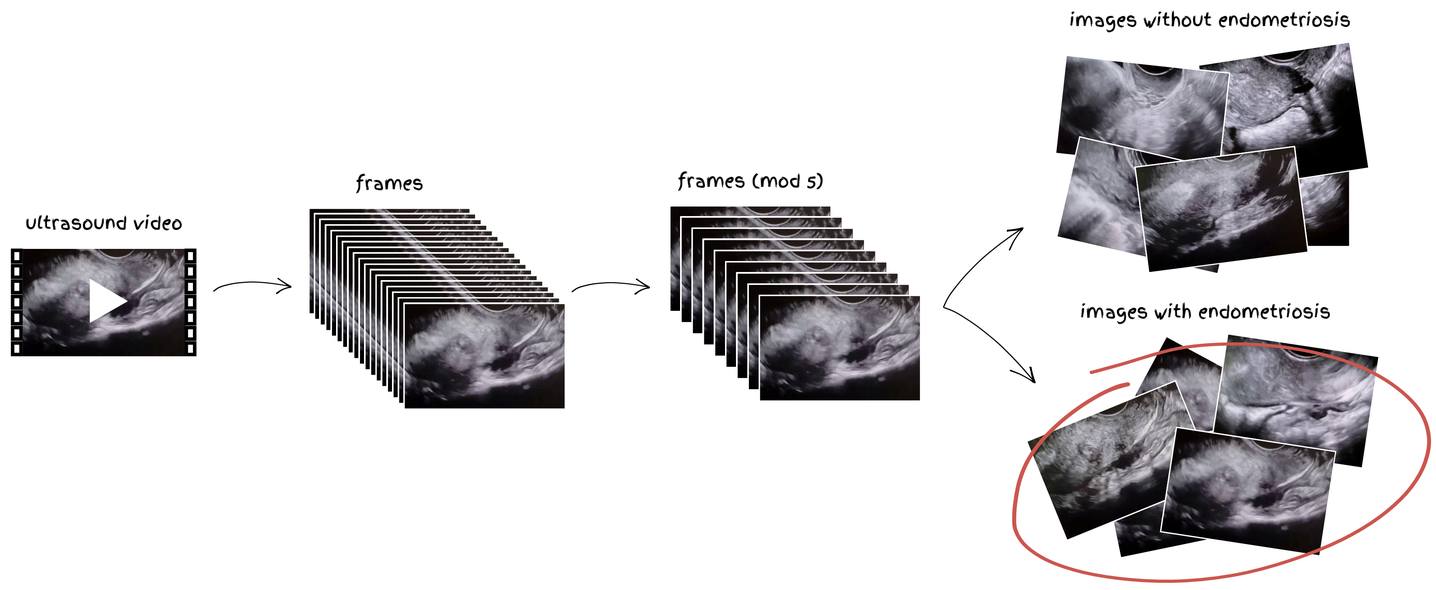
Data description

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:

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

Finally, we compute the average value for each metric.

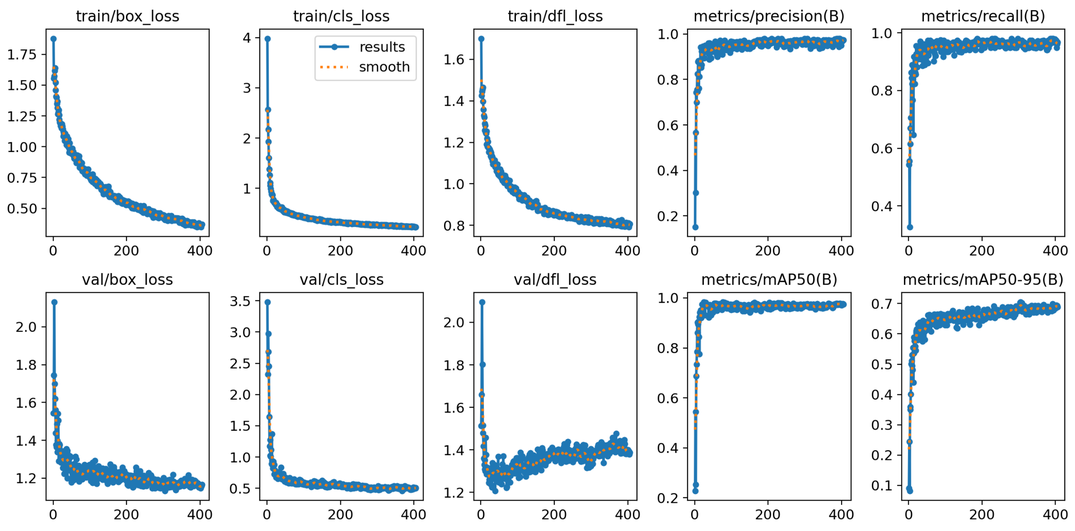
Data augmentation

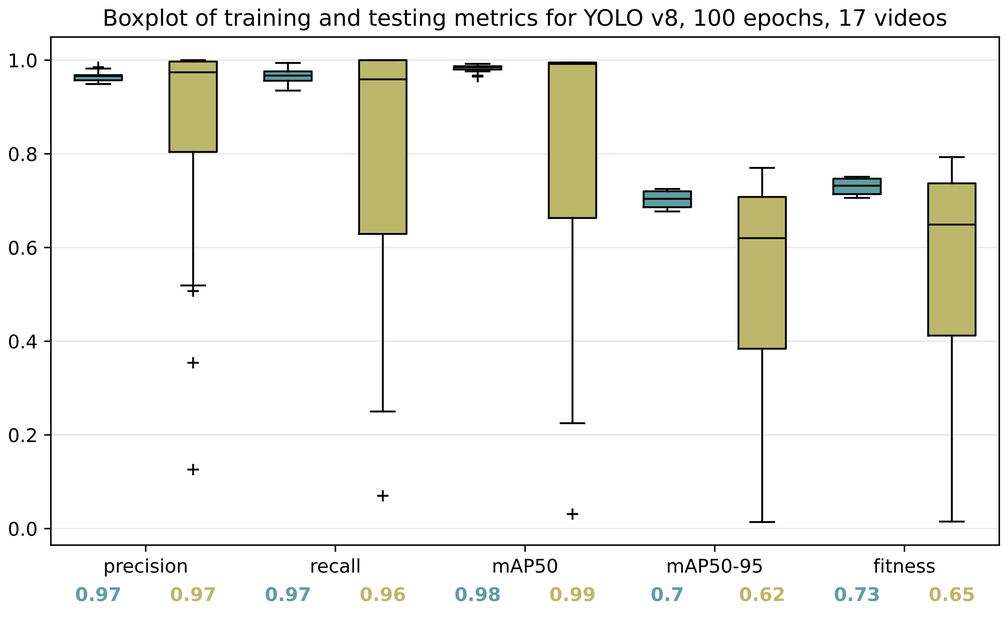
- hue, saturation, value = 0.015, 0.7, 0.4
- translate = 0.1 (fraction of the image size)
- scale = 0.5
- erasing = 0.4 (probability)

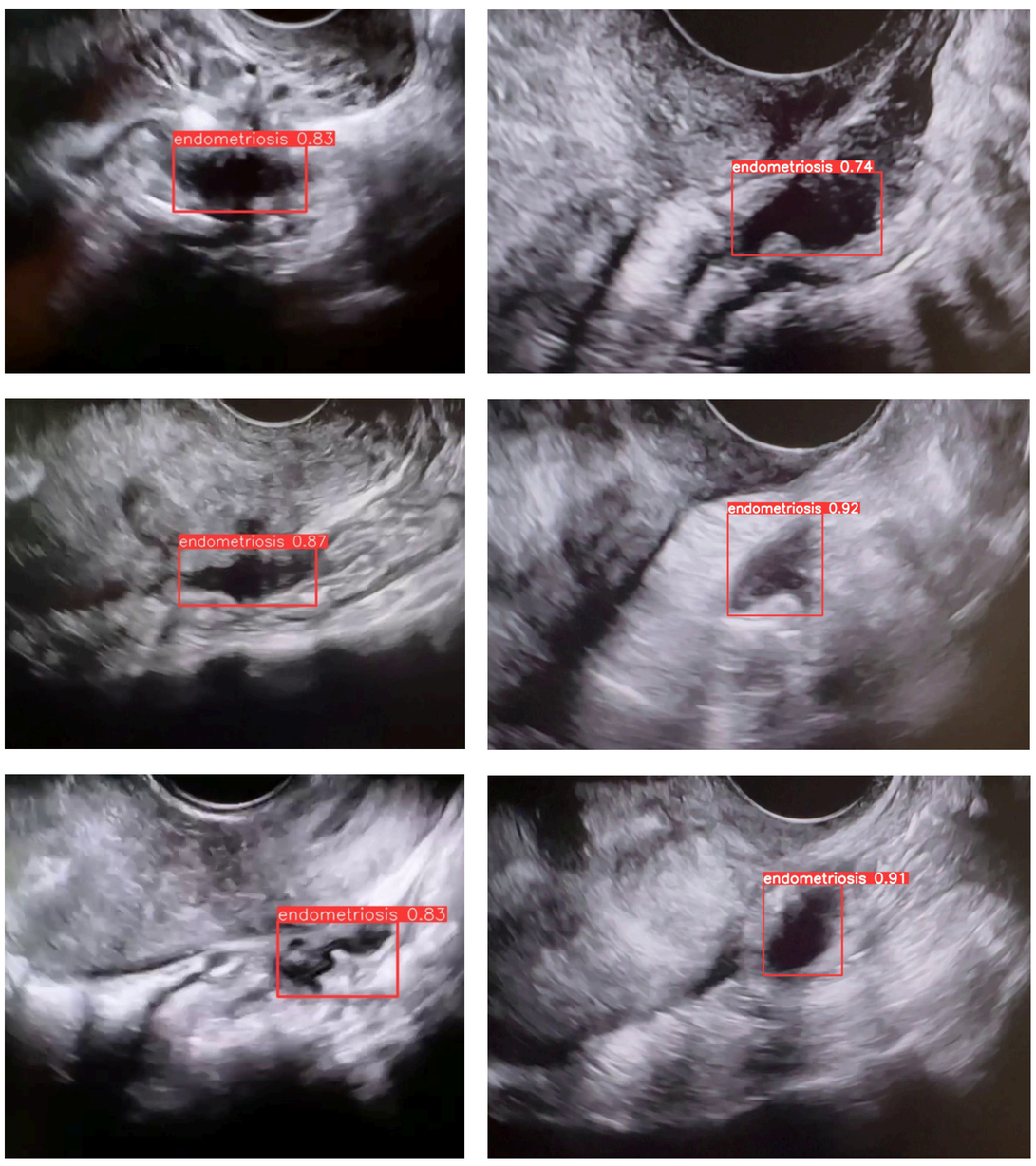
Metrics

- **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







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