



Ring Detection and Pose Estimation

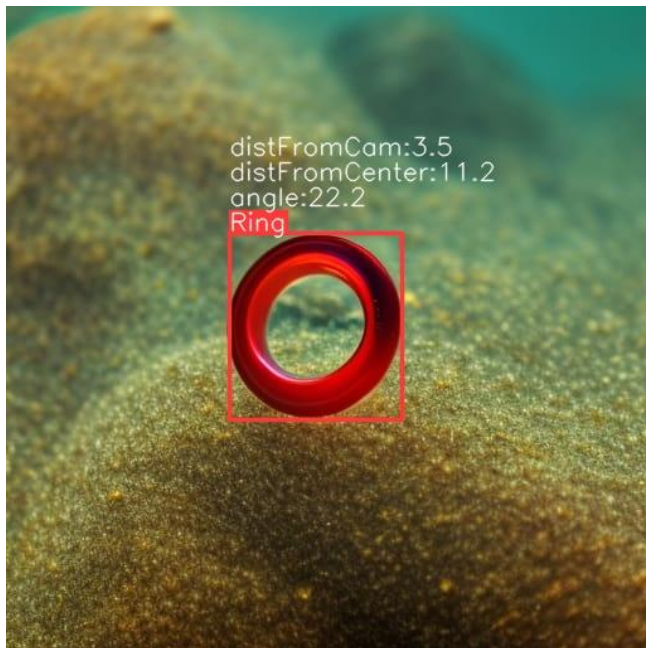
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Objectives

1. Generate a detector for BlueROV that can:
 - 1.1. Detect red rings under water
 - 1.2. Estimate the distance and angle of the ring with respect with the BlueROV
2. The detector works in real time.

Demo first!



[Link to the Video!](#)



Algorithm

YOLO v5

Github : <https://github.com/ultralytics/yolov5>

License for modification : <https://github.com/ultralytics/yolov5/blob/master/LICENSE>



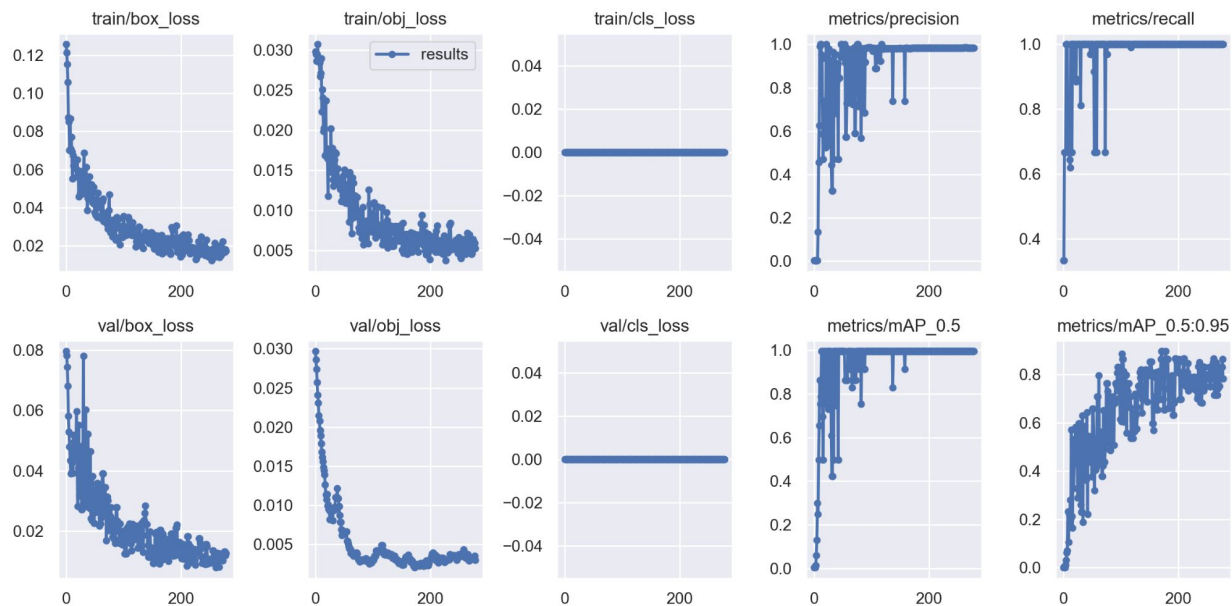
Training

Training images : 36
Cross-Validation : 3
Epocs : 278
Precision : 0.98

Note:

- We added additional white noise in the training set to make the model stronger.
- The model is overfitting, but can be solved with a larger training data set.

Training Results





Distance Estimation

Distance from Camera

Case I (If bounding-box's height in pixel is known at a known distance):

Focal length = $(\text{known_pixel_height} * \text{known_distance}) / \text{known_height}$

Distance = $(\text{known_height} * \text{focal_length}) / \text{pixel_height_now}$

Case II (If no prior information):

Assumption : When the object is at distance zero, either bbox's height or width is equal to the whole frame's height or width.

Distance = $\text{frame_size} / \max\{\text{pixel_height_now}, \text{pixel_width_now}\}$

Distance from Center of image frame

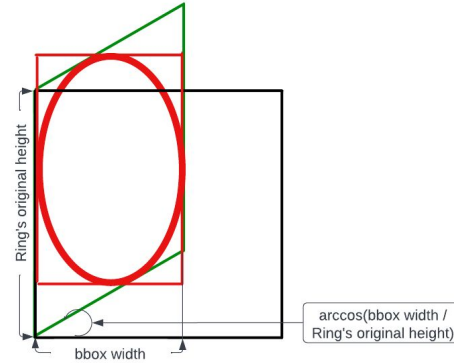
Euclidean distance

Angle Estimation

$\text{Theta} = \arccos(\text{bbox width} / \text{Ring's original height})$

Assumption: The height of the Ring does not change

This estimation technique only does a rough estimation of the angle, so can be less accurate at some positions. The estimation accuracy can be improved using stereo vision.





Demo for Real Time streaming



Thank You!