COMPUTER VISION

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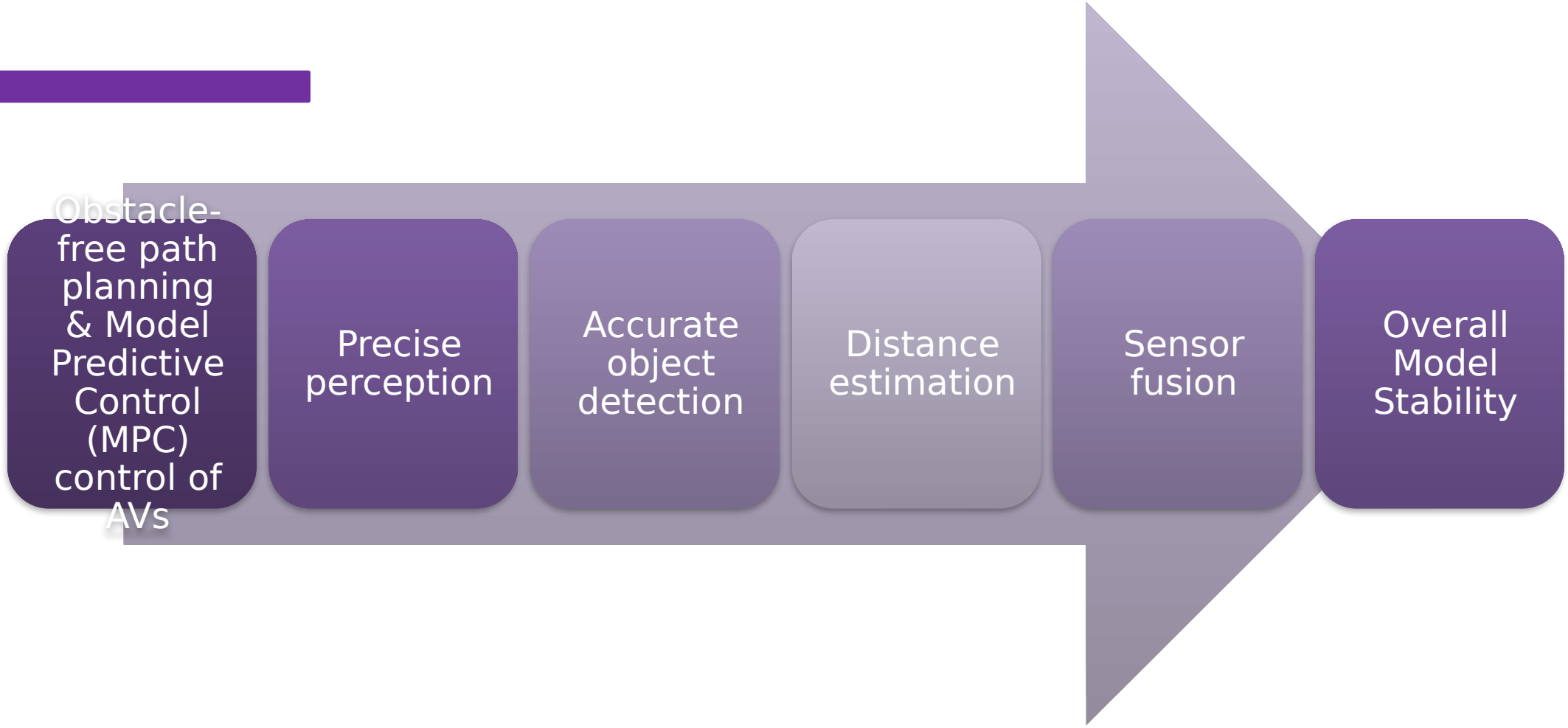
OUTLINE

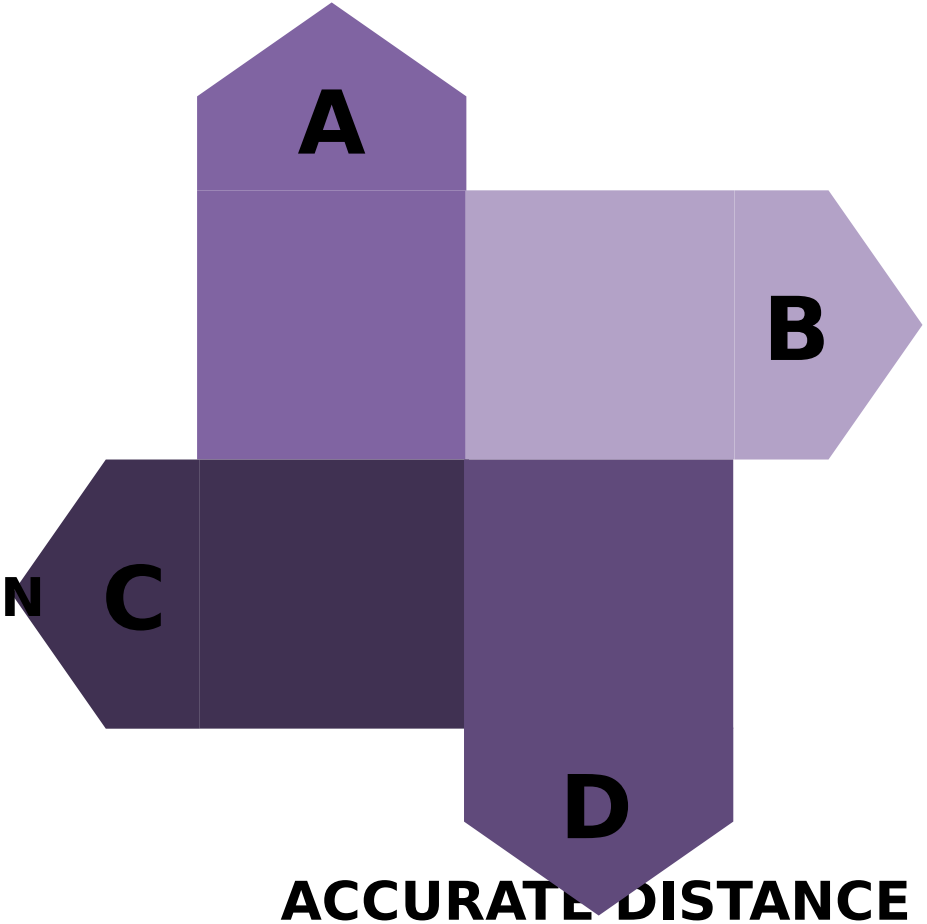
- IDEA & SIGNIFICANCE
- CHALLENGES
- STAGES OF IMPLEMENTATION
- RESULTS
- METRIC EVALUATION
- LIMITATIONS

MAIN IDEA & SIGNIFICANCE



CHALLENGES

SINGLE SENSOR



FAULTY SENSOR READINGS & SENSOR MALFUNCTION

OBJECT DETECTION

ACCURATE DISTANCE ESTIMATION

RELATED WORK

CAMERA

YOLOV2

Detecting multi-scale objects

YOLOV3

Depending on logistic regression (classification)

LIDAR

LaserNet

low inferencing speed (low fps)

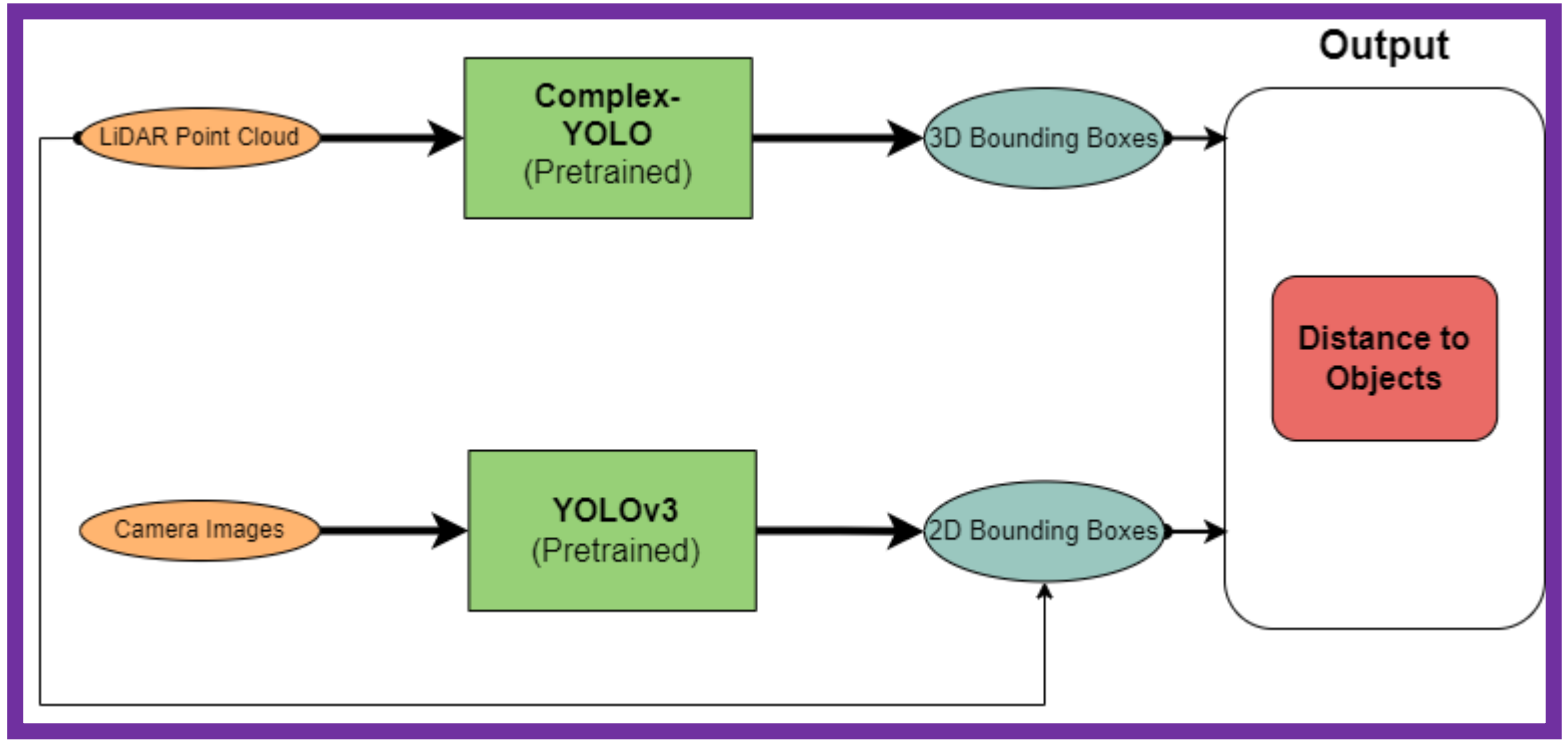
Frustum based network

dependence on multiple sensor data

COMPLEX-YOLO

it has very high fps rate (50 fps) and depends only on lidar data.

MAIN CONTRIBUTION

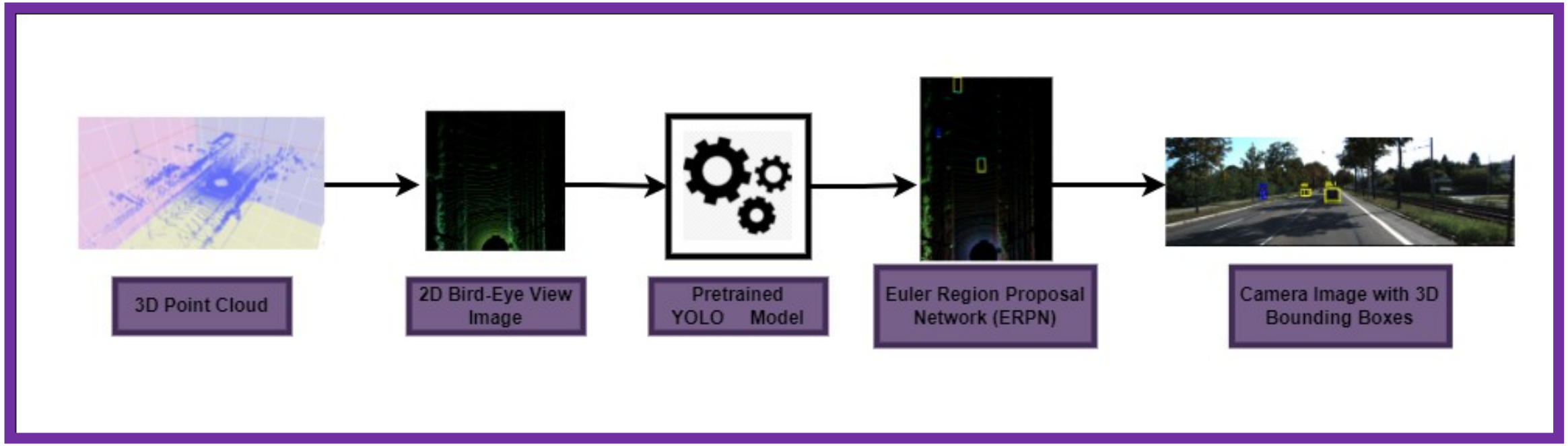


KITTI DATASET

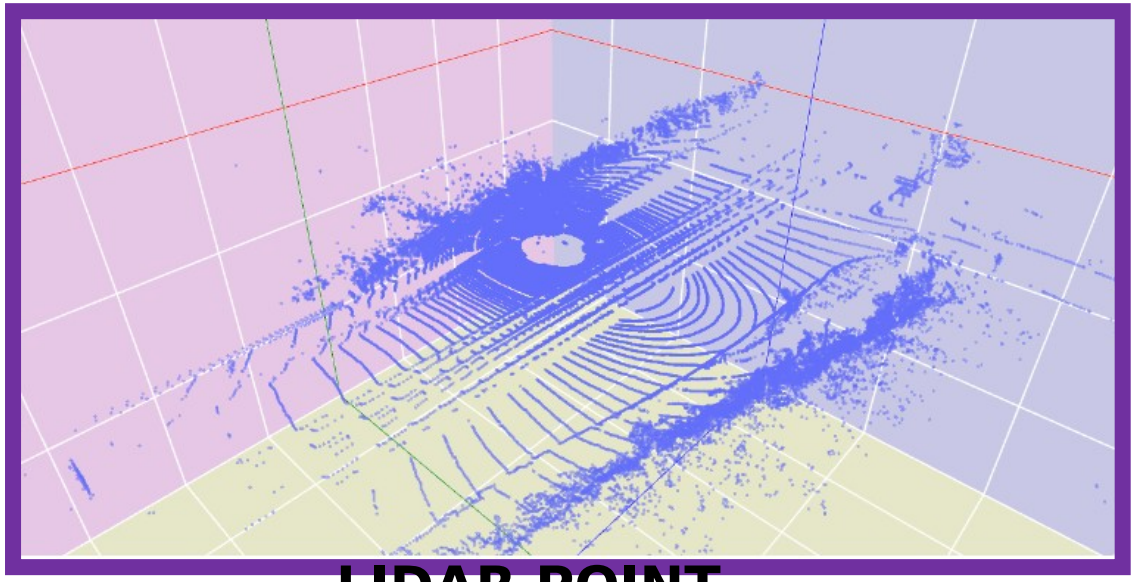
Velodyne	contains 3D point cloud
Image	contains RGB images obtained from camera (used for visualization)
Label	contains the ground truth bounding boxes and labels
Calibration	contains transformations between LiDAR coordinates and camera coordinates

STAGES OF IMPLEMENTATION

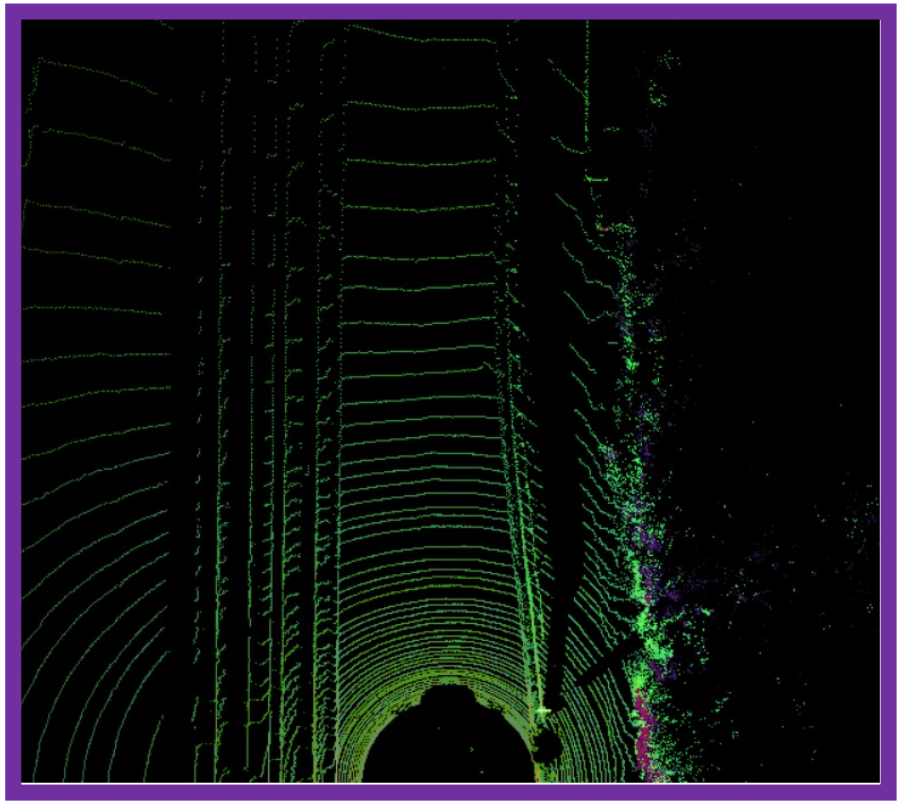
COMPLEX-YOLO (PRE-TRAINED)



DATA PREPROCESSING



LIDAR POINT CLOUD



BIRD EYE VIEW

DATA PREPROCESSING

$$z_g(\mathcal{S}_j) = \max(\mathcal{P}_{\Omega i \to j} \cdot [0, 0, 1]^T)$$
$$z_b(\mathcal{S}_j) = \max(I(\mathcal{P}_{\Omega i \to j}))$$
$$z_r(\mathcal{S}_j) = \min(1.0, \log(N + 1)/64) \quad N = |\mathcal{P}_{\Omega i \to j}|$$

YOLO MODEL

	Yolo v3	Yolo v4
Image size	608 x 608 x 3	608 x 608 x 3
Convolution Layers	106	110
Batch Size	64	64
Momentum	0.9	0.949
Learning Rate	0.001	0.0013

EULER REGION PROPOSAL NETWORK (ERPN)

Divide image into 16 and 32 grid cells

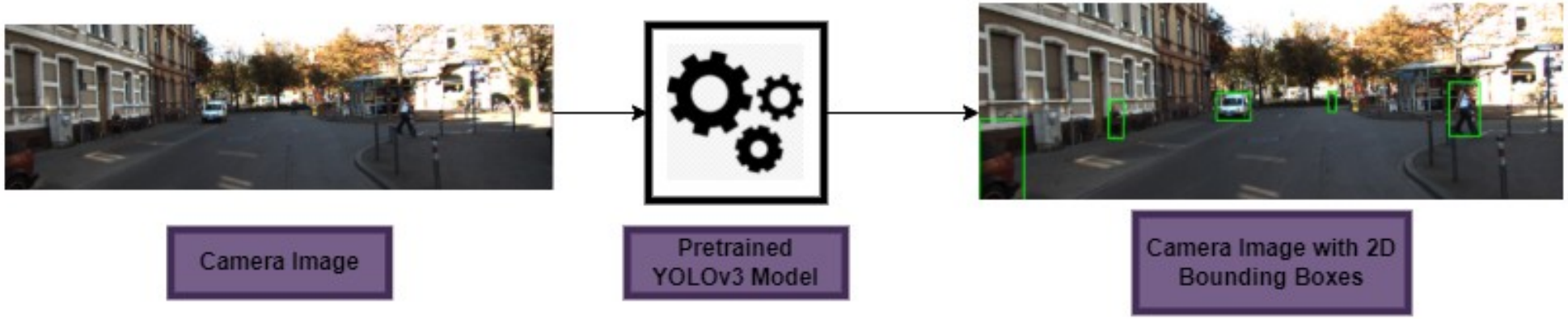
Each grid cell is responsible for 5 bounding boxes

Each bounding box has the following parameters:

- Objectness probability
- 3 class probabilities (car, cycle, pedestrian)
- 6 parameters (x, y, w, h, real angle, imaginary angle)
- 5 additional parameters (alpha, cx, cy, pw, pl)

SO, EACH GRID CELL IS RESPONSIBLE FOR 5 * (6 +1 +3 +5) = 75 FEATURES

YOLOV3 (PRE-TRAINED)

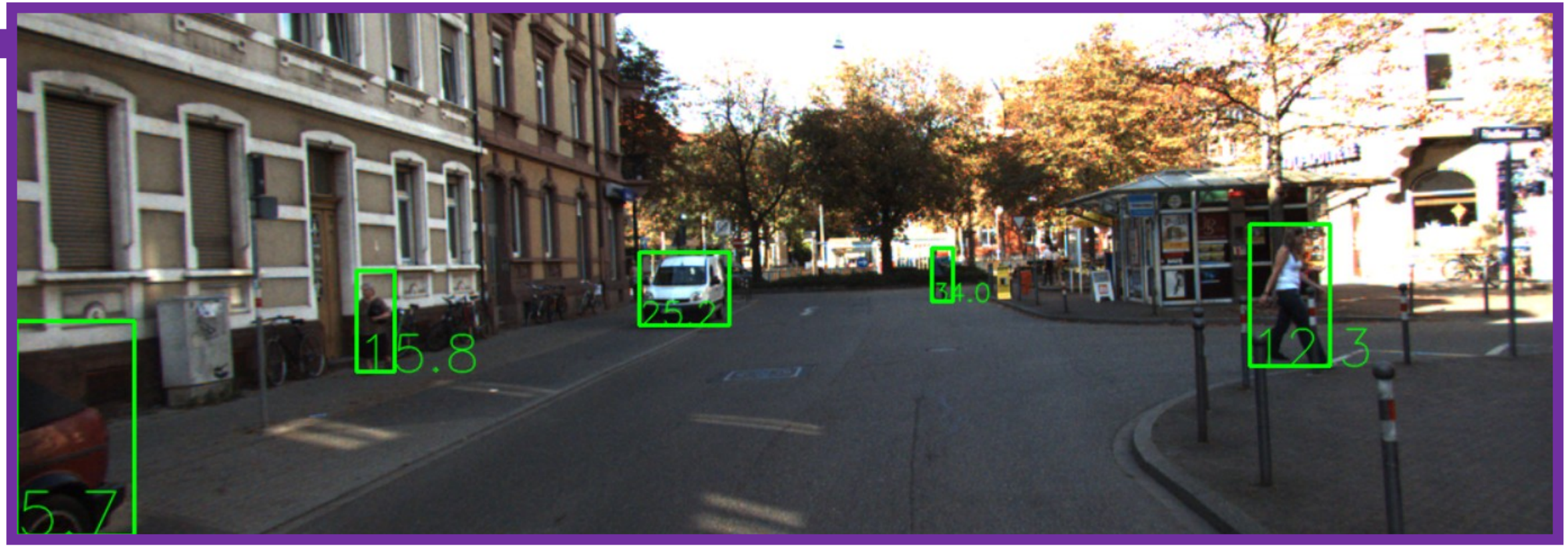


RESULTS

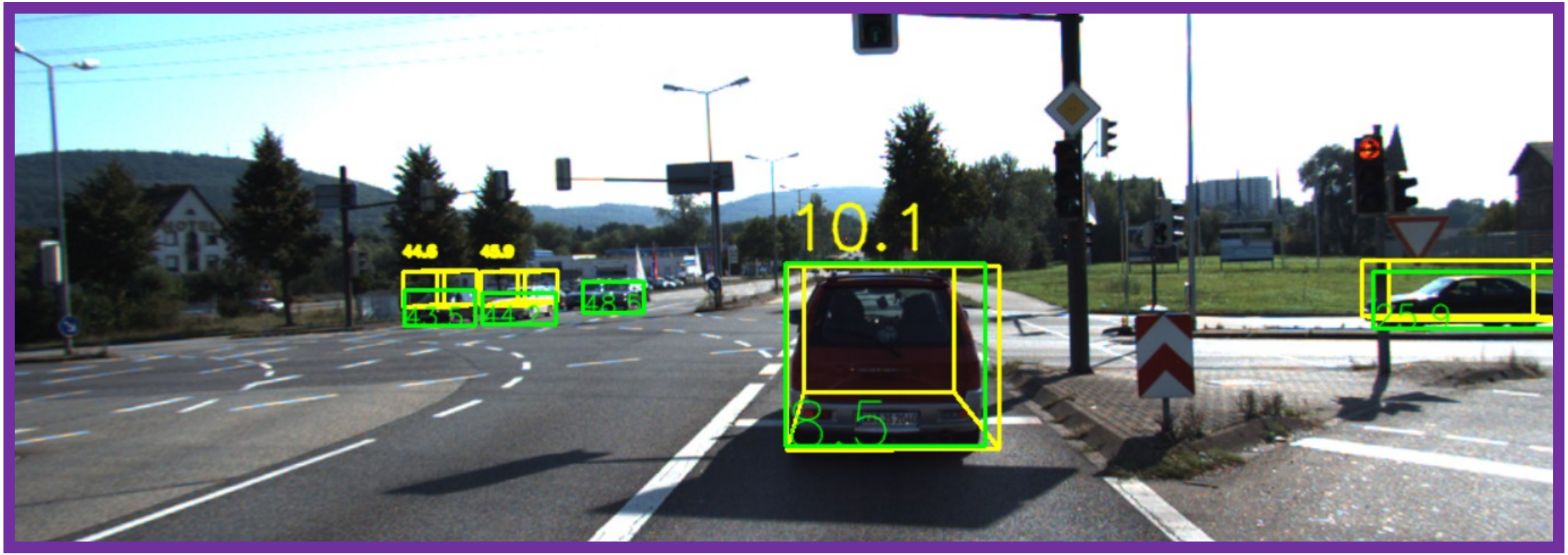
COMPLEX-YOLO3

COMPLEX-YOLO4

YOLOV3



COMBINED OUTPUT



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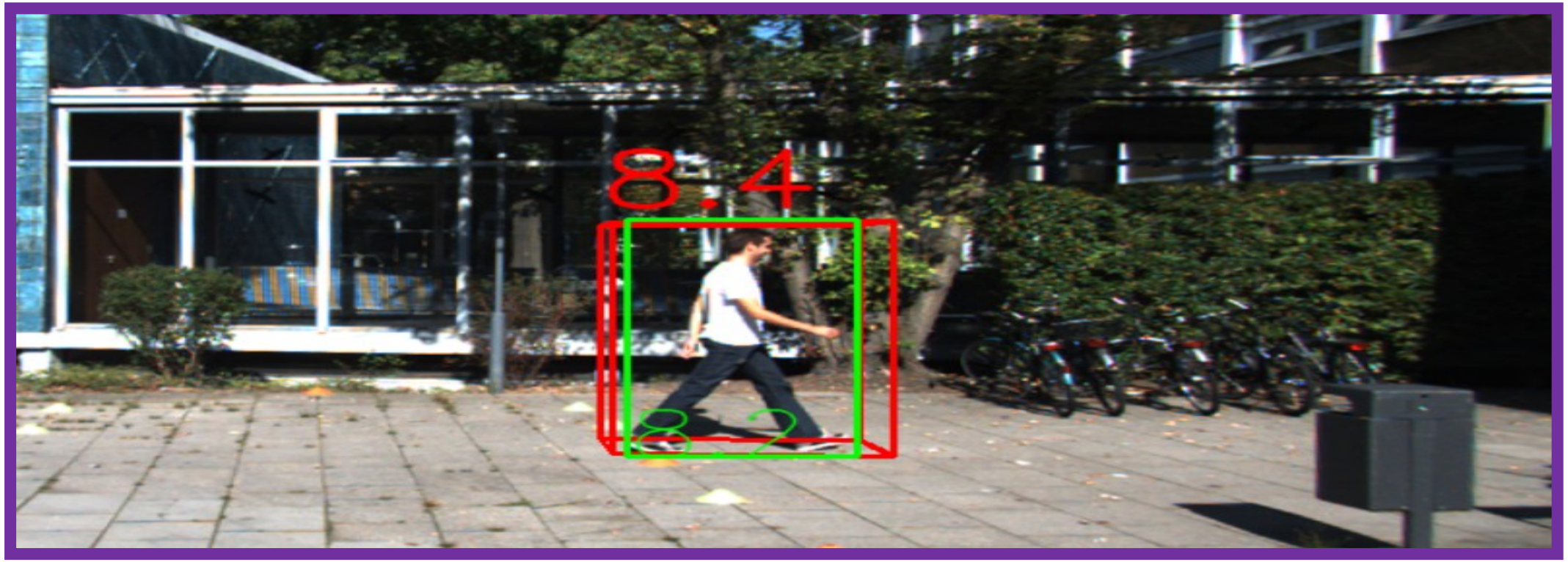
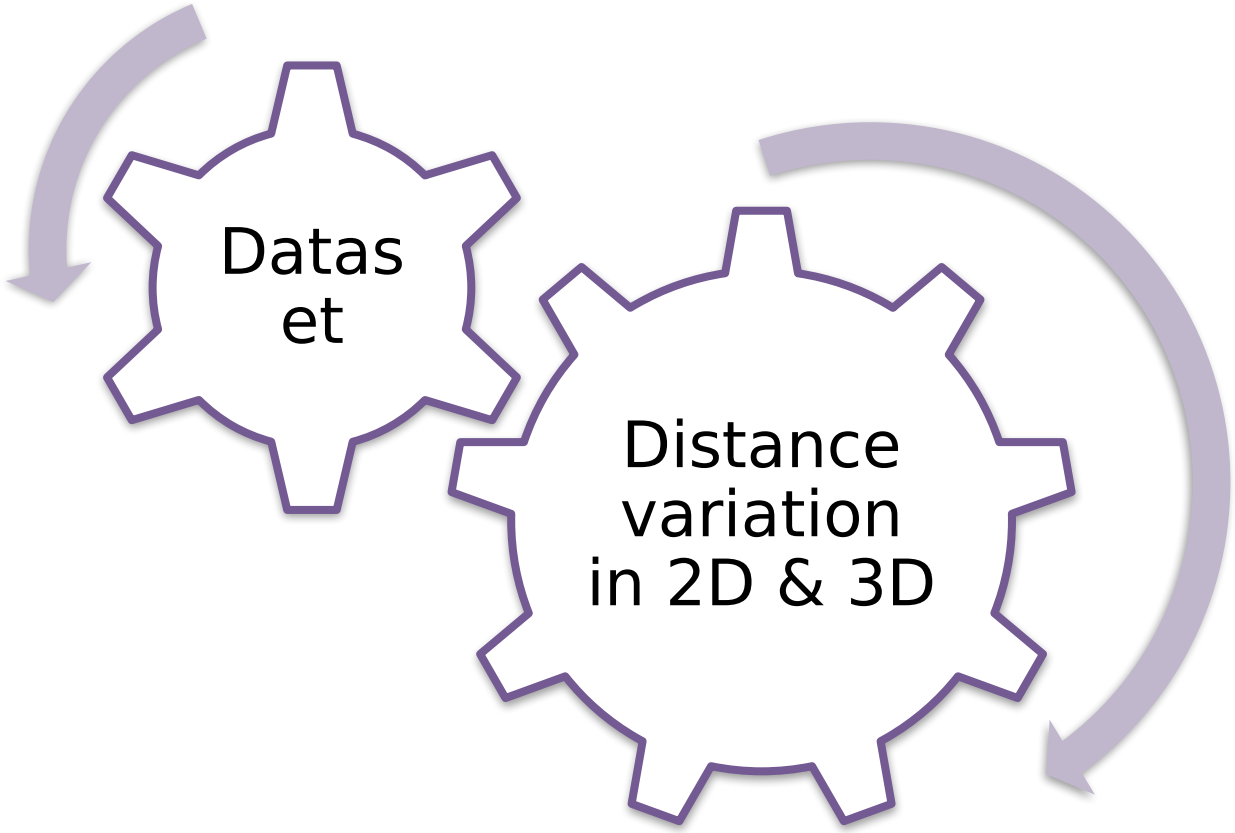


METRIC EVALUATION

Model	AP(Class Car)	AP(Class Pedestrian)	AP(Class Cyclist)	Model mAP
Complex-YOLOv3	0.98	0.75	0.75	**0.833**
Complex-YOLOv4	1	0.86	1	**0.95**

LIMITATIONS



THANK YOU!