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# COSE474-2024F: Final Project Proposal

## “Improving 3D Object Detection Accuracy on Roads under Adverse Weather Conditions”

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### 1. Introduction

- Autonomous driving technology has been rapidly advancing in recent years, with 3D object detection playing a crucial role in identifying and recognizing objects on the road in real-time. However, under adverse weather conditions (e.g., rain, snow, fog), the quality of sensor data can degrade significantly, leading to a substantial drop in detection accuracy. This situation can pose a major threat to the safety and reliability of autonomous driving systems.
- This research aims to propose new methods to improve the accuracy of 3D object detection under adverse weather conditions, enhancing the environmental perception capabilities of autonomous vehicles to enable safer driving.

### 2. Problem definition

In adverse weather conditions, such as rain, snow, or fog, the quality of sensor data (e.g., camera, LiDAR, radar) deteriorates, resulting in decreased object detection performance. For example, LiDAR data may have lower reflectivity, leading to higher levels of noise, while camera images can become blurry or obscured.

### 3. Challenges

- **Generalization Across Different Weather Conditions:** The model must generalize well across various types of weather (rain, snow, fog) to be effective in real-world applications.
- **Noise and Data Quality:** Adverse weather introduces various types of noise and data quality issues, such as lower reflectivity in LiDAR point clouds, visual occlusions in camera images, and decreased accuracy in radar measurements.
- **Real-time Processing Requirements:** Achieving high accuracy while maintaining real-time performance is challenging under adverse conditions due to the increased complexity of the data.

### 4. Related Works

1. Complex-YOLO: Real-time 3D Object Detection on Point Clouds (16 Mar 2018, Martin Simon)
2. Image-Adaptive YOLO for Object Detection in Adverse Weather Conditions (15 Dec 2021, Wenyu Liu)
3. Domain Adaptation based Object Detection for Autonomous Driving in Foggy and Rainy Weather (18 Jul 2023, Jinlong Li)

### 5. Datasets

- KITTI
- Waymo Open Dataset
- Foggy Cityscapes

### 6. State-of-the-art methods and baselines

- Complex-YOLO
- PointPillars

### 7. Schedule

Proposal (17 Oct 2024)