

Abstract

Parking lots are a dominant feature of the American landscape, with more than 8 spots per registered car in the US. This surplus of parking spaces has numerous consequences, including reinforcing car dependency, exacerbating traffic congestion, contributing to urban heat islands, generating runoff, and occupying valuable space that could otherwise add vitality to neighborhoods and generate revenue for cities.

The COVID-19 pandemic altered behavior and mobility patterns worldwide. Countries like Switzerland have capitalized on this opportunity to quantify the changes in parking patterns using Internet of Things (IoT) technologies. However, the United States lacks a centralized data source for parking occupancies in its cities. To bridge this gap, we aimed to leverage computer vision technologies to detect vehicles and analyze parking pattern changes in Durham, NC.

Research Question

- How does computer vision perform on vehicle detection tasks through satellite imagery?
- How did COVID-19 impact park lot occupancy in Durham?

References

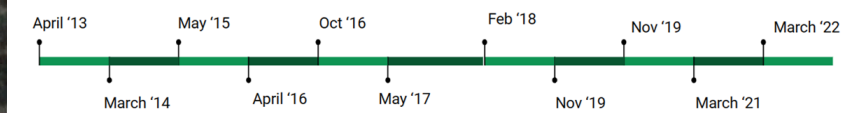
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Methods: Satellite Imagery + Computer vision



Fig. 1: Vehicle Detection Using YOLO v5

- Parking lots: 18 commercial surface lots in Durham from Google Earth Pro
- Timestamps: 11 timestamps from 2013-2023



- Vehicle detection algorithm: YOLO v5
- Training/Validation Dataset: VehSat
- Algorithm Performance:
 - 92.572% Precision
 - 72.288% Recall

Results

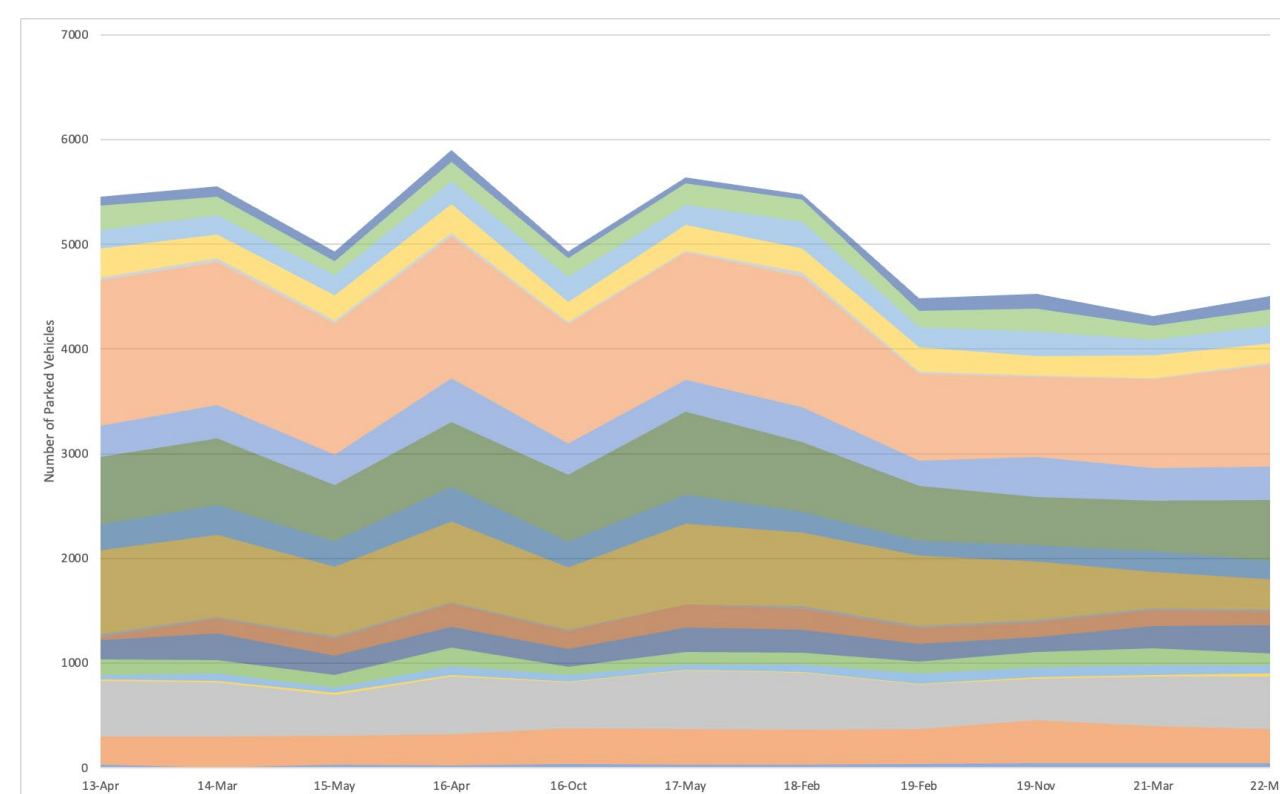


Fig. 2: Number of Parked Vehicles across 2013 - 2023

- Parking Trends:
 - High variability among parking lots
 - Decline between 2018 and 2019 - (immediately) before covid
 - No significant sign of recovery after covid

Conclusion

- YOLO is capable of object detection tasks through satellite imagery with proper training datasets
- No obvious trend so cannot link COVID-19 and parking occupancy
 - Could be due to difference in strength of U.S. COVID-19 policy
- Parking Lots are oversupplied, but more data would be necessary to verify

Future Works

- Obtain satellite imagery from sources with more timestamps such as WorldView-2 or WorldView-3
- Develop new training dataset

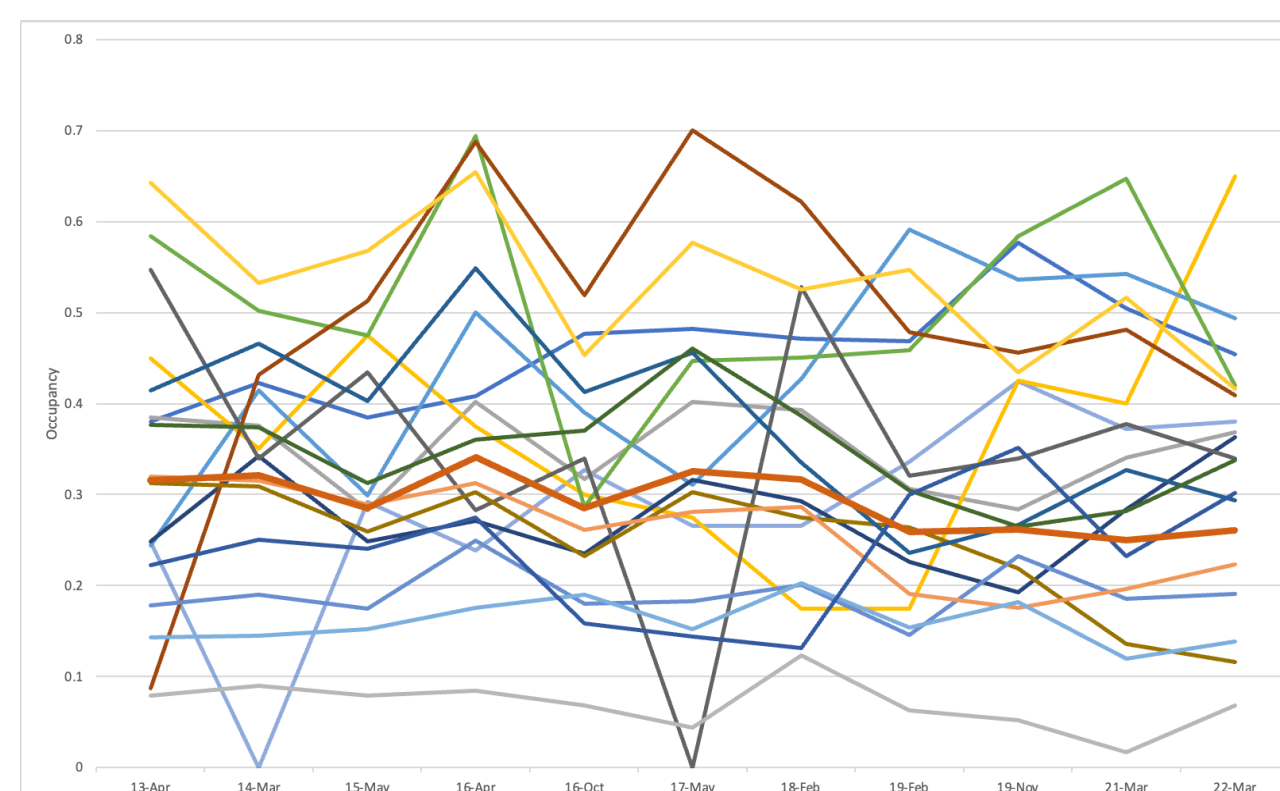


Fig. 3: Occupancy of Parking Lots across 2013 - 2023