Occlusion Detection for Dynamic Adaptation

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Acknowledgements

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DIRS

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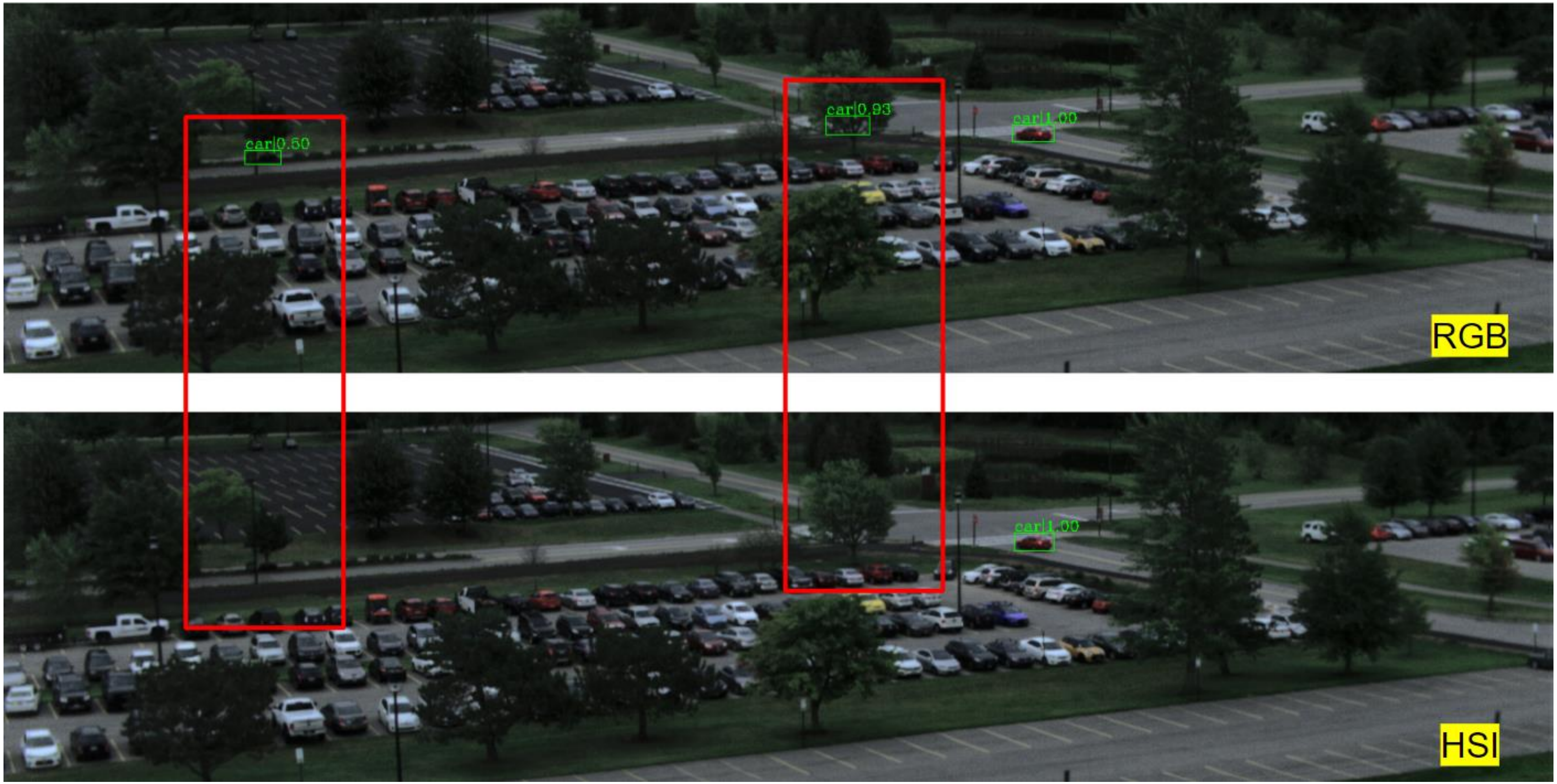
Motivation

- **We are attempting to show that using metadata information such as Open Street Map will aid in detecting occluded and shadowed regions of a scene**

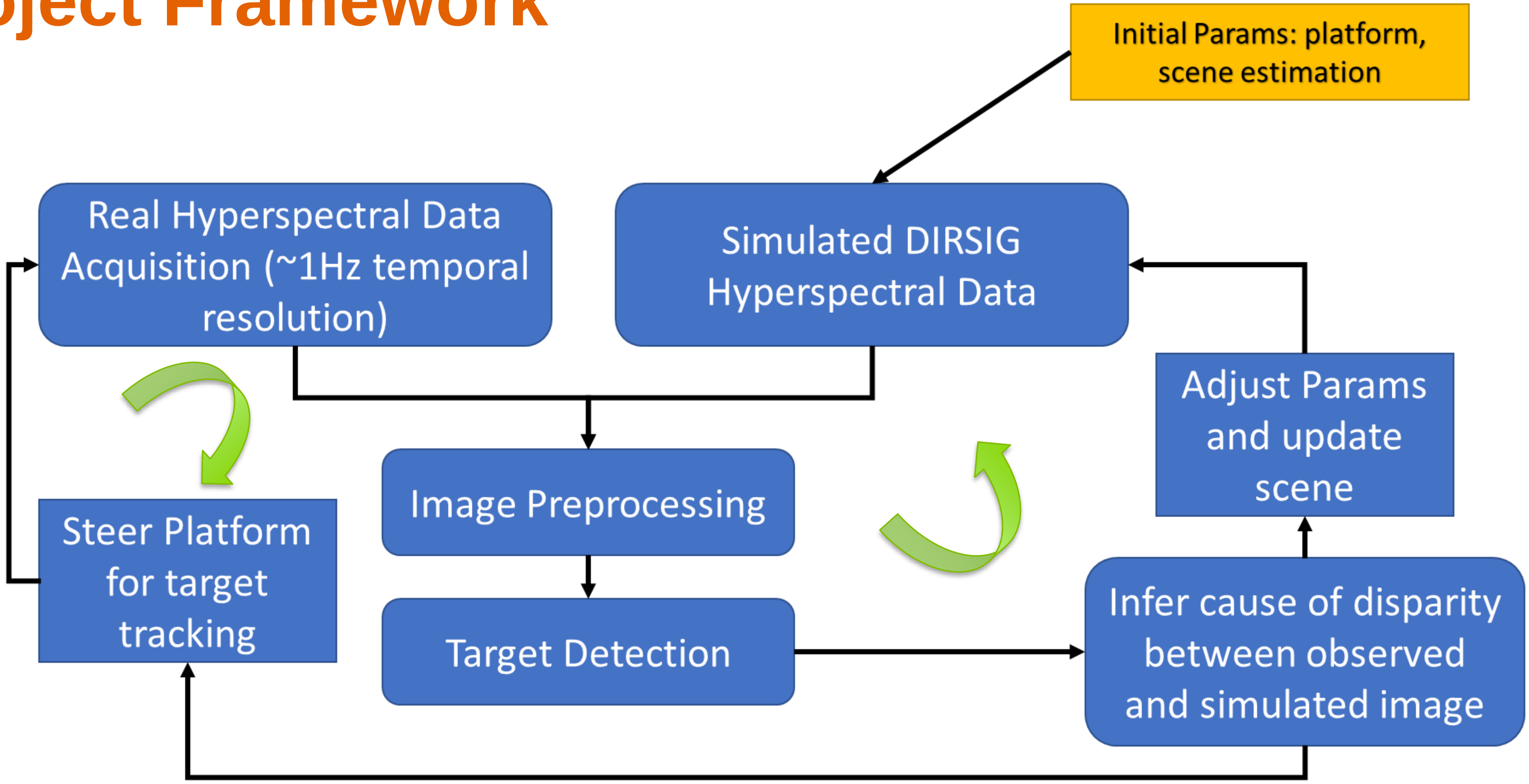
Knowledge of occluded and shadowed regions will help with:

1) Merging vehicle tracks from before and after an occlusion event
2) Reposition airborne platform to location where future occlusion events will be minimized for a target vehicle
3) Predict expected hyperspectral signature of a vehicle

RGB or HSI? What Should We Trust?

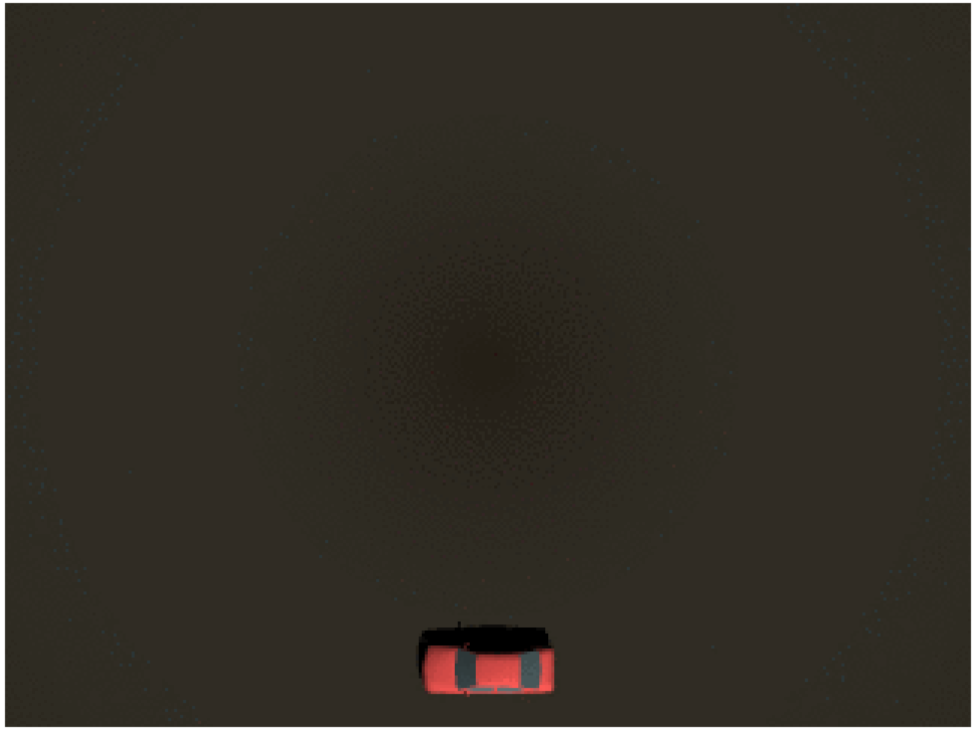


Project Framework



Target Detection → Infer cause of disparity between observed and simulated image

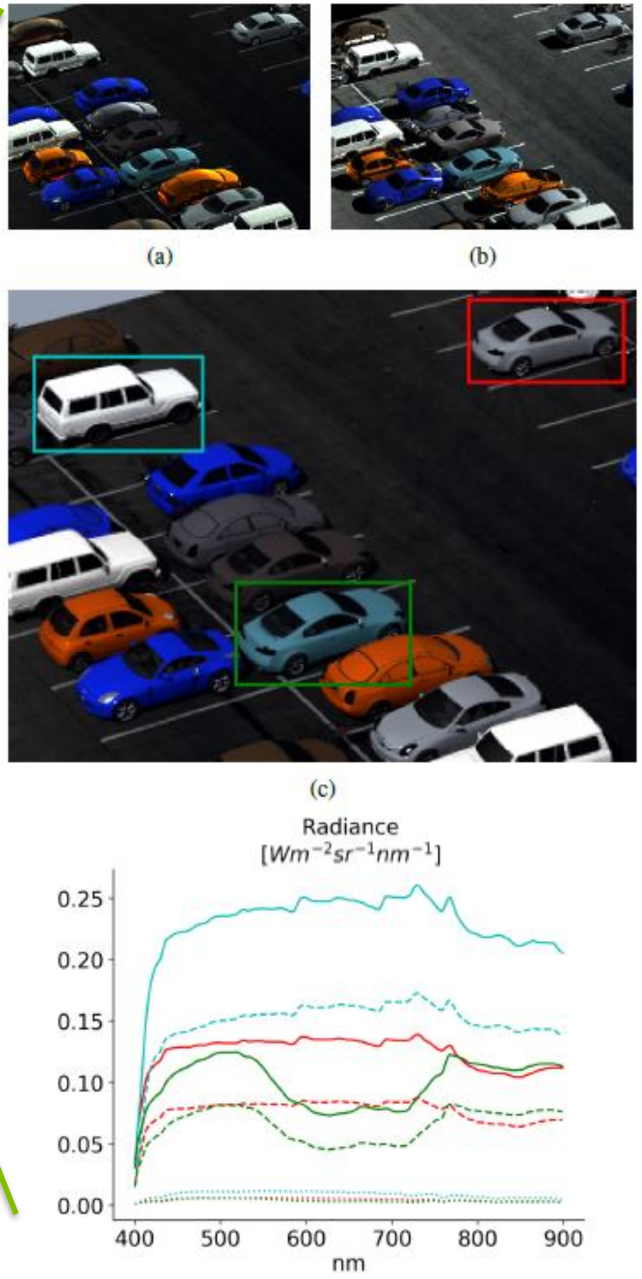
- There is a need to develop a method to infer the cause of disparity between observed and simulated images
  - Common sources of disparity include occlusions, shadows, and atmospheric changes
  - Simulated imagery obtained using Digital Image Remote Sensing Image Generation (DIRSIG)



Simple car simulation using DIRSIG

Benefits of Physics Based Simulated Imagery

- Can adjust weather and atmospheric conditions of scene so that dataset is not biased towards sunny weather imagery
- Augment data with physics equations
- Image same scene with various imaging modalities
- Can change camera and vehicle position at will



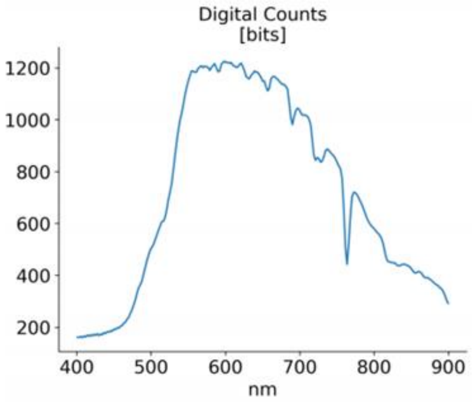
Vehicle Dataset Collection

- **We collected data of over 450 vehicles in a parking lot with a drone platform**

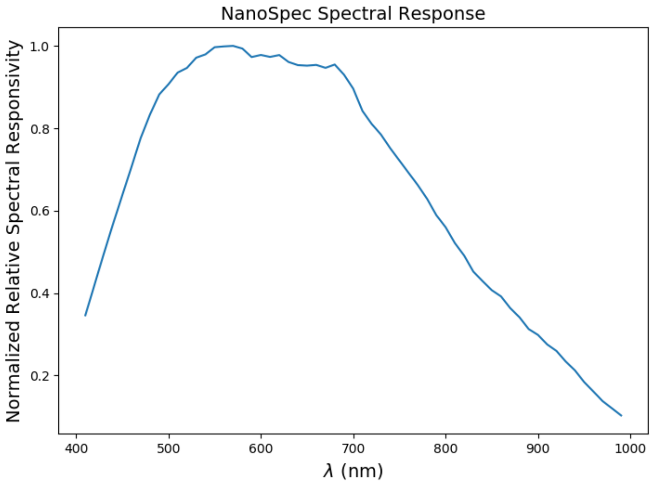
- **Data are converted to reflectance and then imported into DIRSIG (Digital Imaging and Remote Sensing Image Generation) to create simulated physics based hyperspectral imagery of vehicles**

Raw Data to Simulated Imagery

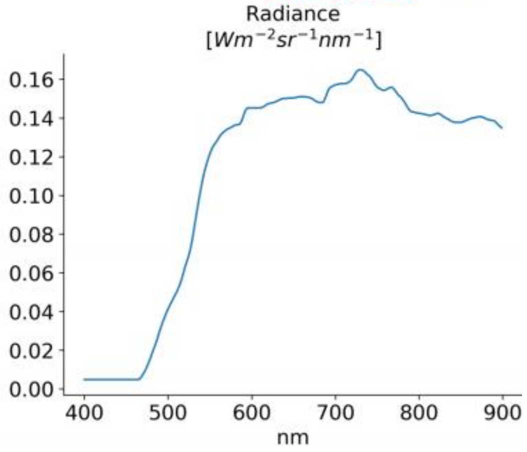
Collect hyperspectral imagery from airborne platform



Calibrate data using lab measured spectral responsivity curve



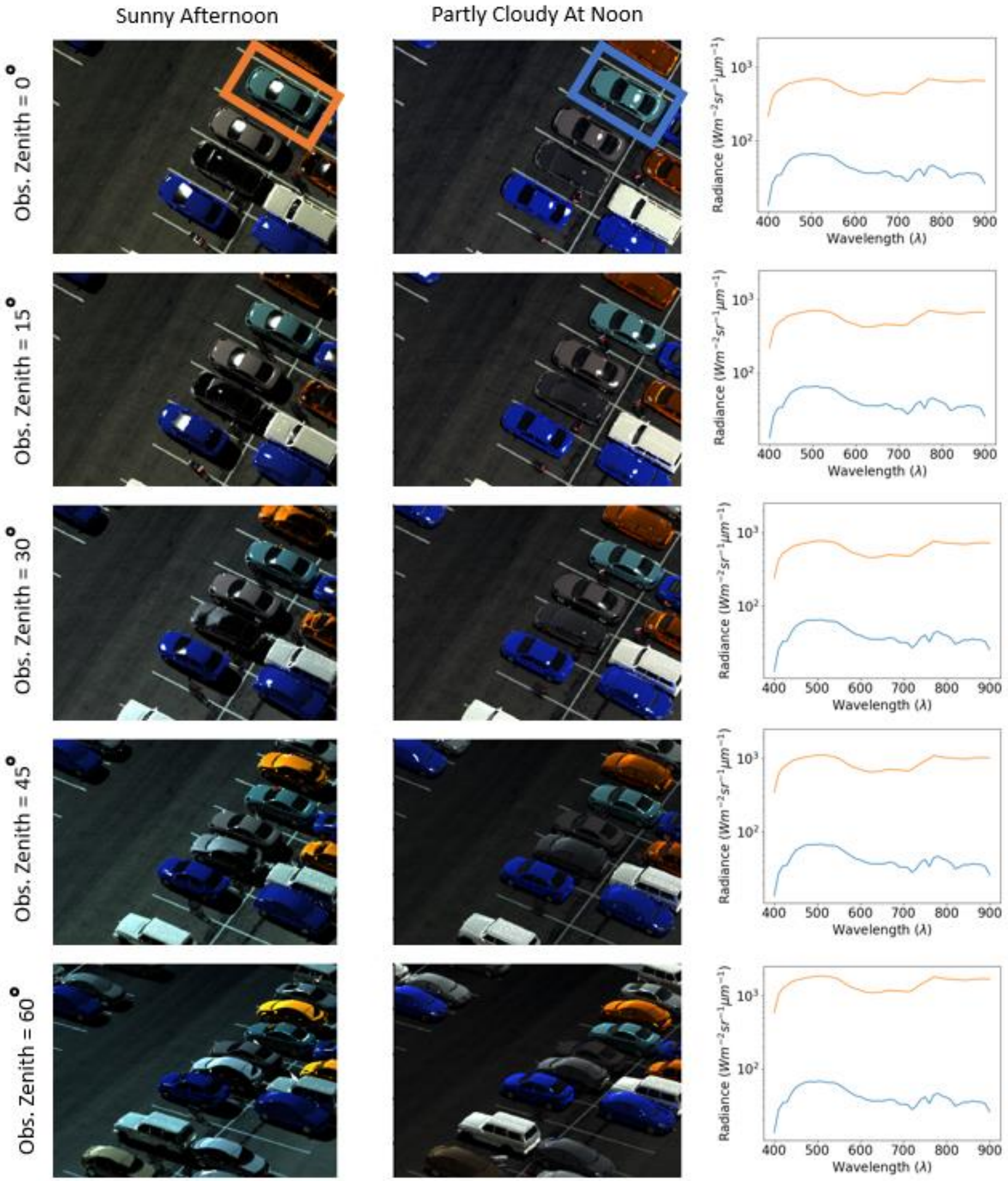
Convert data to spectral reflectance using downwelling irradiance



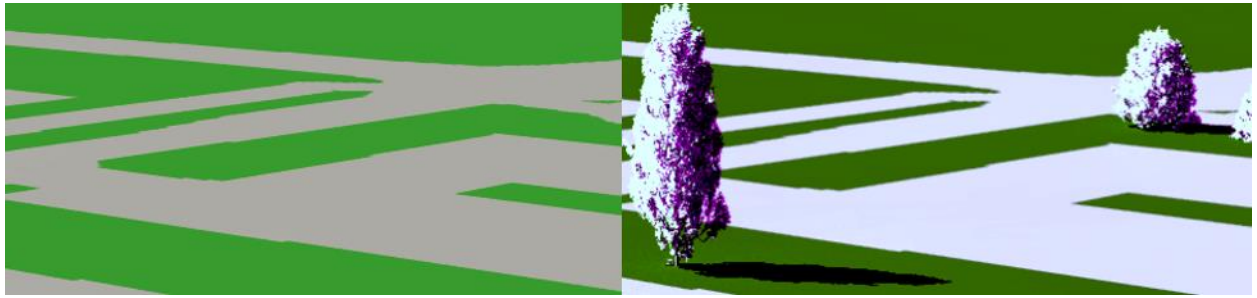
Generate simulated imagery with observed vehicle paint signatures

Observation Angle and Weather

- Expected spectral radiance of target vehicle is iteratively updated based on atmospheric weather and airborne camera orientation



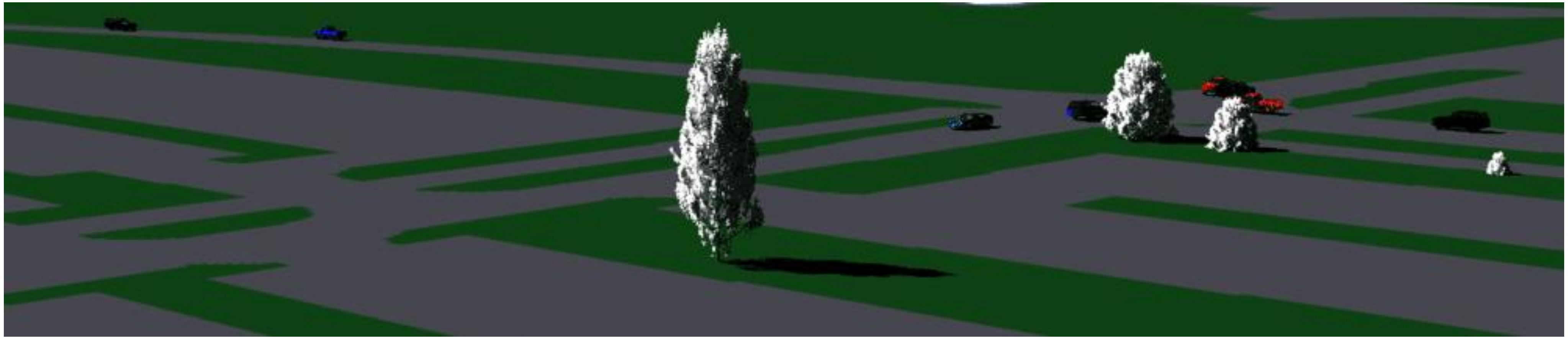
OSM Data for Predicting Occluded Regions

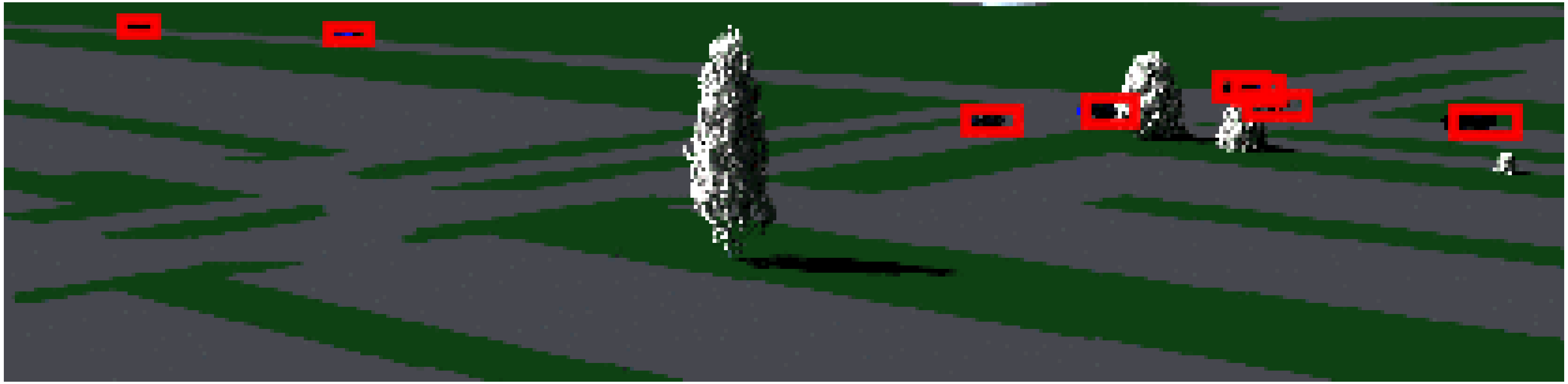


Example of a DIRSIG scene using OSM terrain (left), and addition of trees (right) to the scene to occlude the ground terrain. Green represents ground vegetation and grey/white is paved roads.

Simulated DIRSIG scene with trees (left) and an occlusion and shadow mask ground truth image (center) showing all occluded and shadowed pixels in the scene in white. On the right is the result of a spectral angle classification that is used to detect change between the initial ground terrain image and a simulated observed image frame containing trees

Simulated Hyperspectral Data





Conclusion

- In a DDDAS framework, we dynamically update a physics based simulated scene as occluded regions are detected
- Online executing simulated imagery predicts the expected spectral radiance signature of a target vehicle as it moves through an environment
- Labeled vehicle bounding box dataset of simulated hyperspectral imagery is created to train vehicle detection and tracking algorithms

Thank You

Any Questions?