# Making Micromobility Smarter and Safer

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SCC-IRG Track 2, FY2021

## Background and Objectives

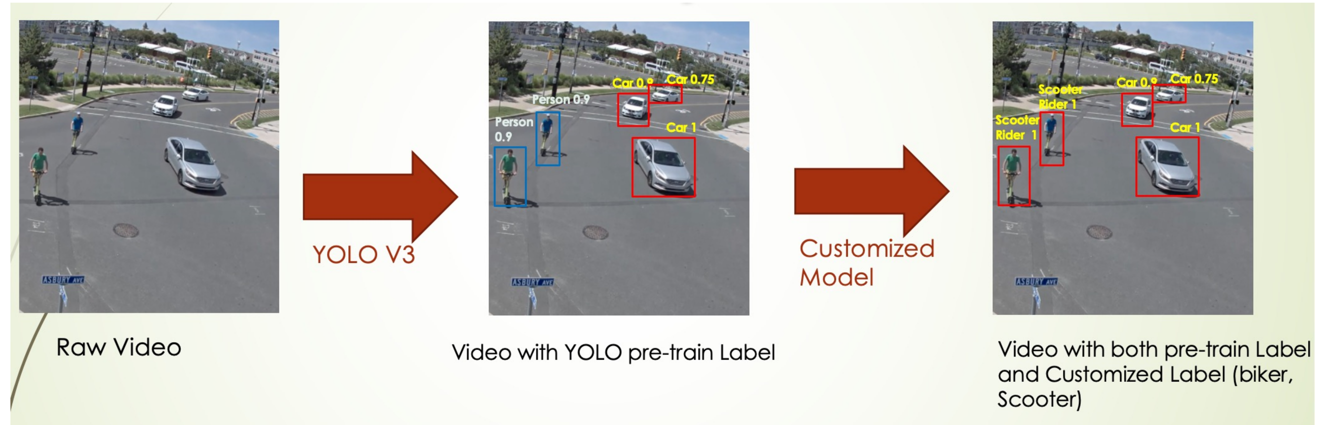
- Urban transportation is experiencing rapid changes with the introduction of new micro-mobility options. Within this mix of new modes, pedestrians face substantial and growing risks on American streets where road designs cater to drivers and automobiles dominate numerically.
- How do we **increase** the quality and quantity of **data** on pedestrian & micro-mobility risk?
- What **factors increase the risk** of vulnerable road user near-miss conflicts?
- How do we drive vulnerable road user fatalities to **zero** for all road users?

## Intellectual Merit

- To develop a test bed equipped to evaluate social, technological, and integrated risk-reduction strategies for vulnerable road users. We do this by developing computer vision algorithms to more accurately detect pedestrians, micromobility vehicles, and motor-vehicles; to measure trajectories; to measure near-misses; and to distinguish key user attributes.
- To acknowledge the sequencing and layering of social and technological strategies as part of an integrated risk reduction portfolio. Explicit experiments to test the efficacy of social, technological, and integrated innovations will be conducted.
- The use of an integrated simulation model as part of a community deliberation will reveal insights about the efficacy of these approaches.

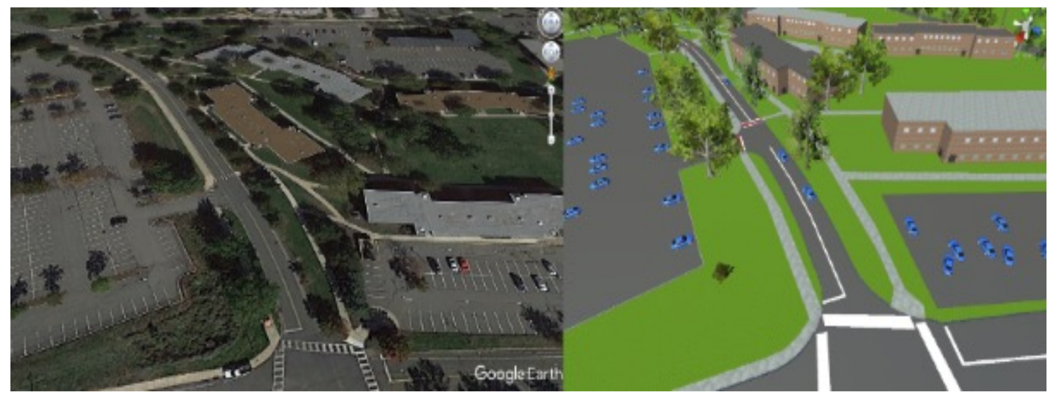
## Detecting Near-Misses

- Current models do not have the capability to identify e-scooters. We fill this gap by developing an algorithm that can discern between pedestrians and e-scooters.
- Our cascade model has a 83% accuracy of detecting e-scooters.



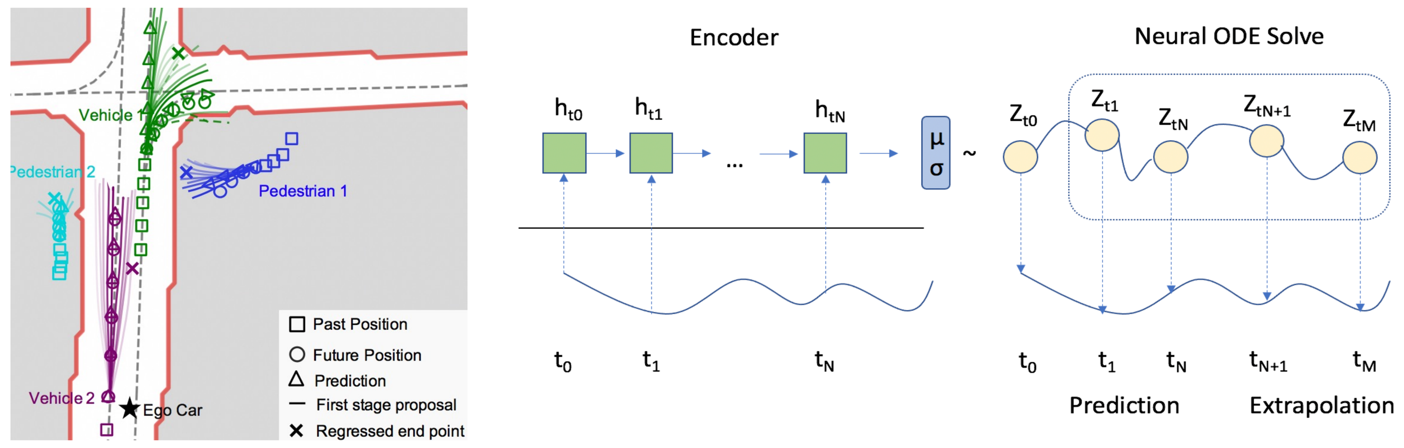

## Virtual Reality Simulations

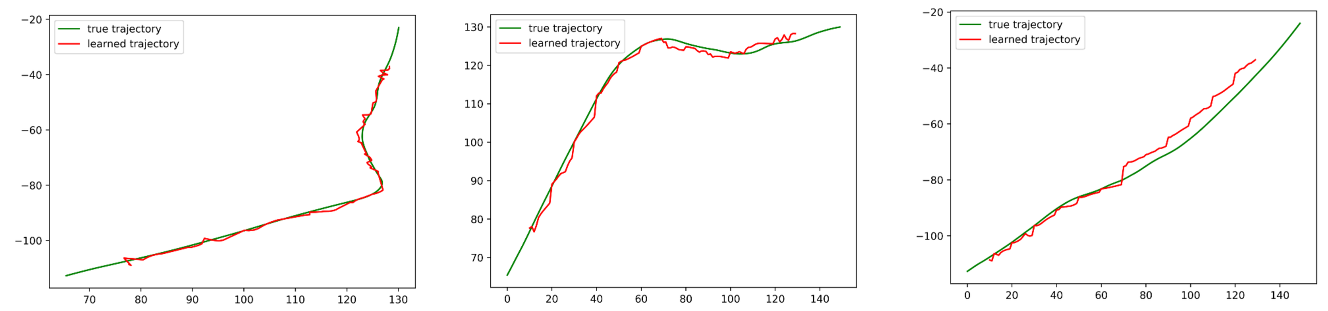
- Design and build a VR e-scooter simulator. (test city: Asbury Park, NJ)
- Test and validate the built simulator by human subject experiment, and generate near miss data.
- Analyze the near miss data to look for accident causing factors, provide safe riding suggestions and infrastructure change suggestions.
- Benefit: To test different safety scenarios in a safe environment.



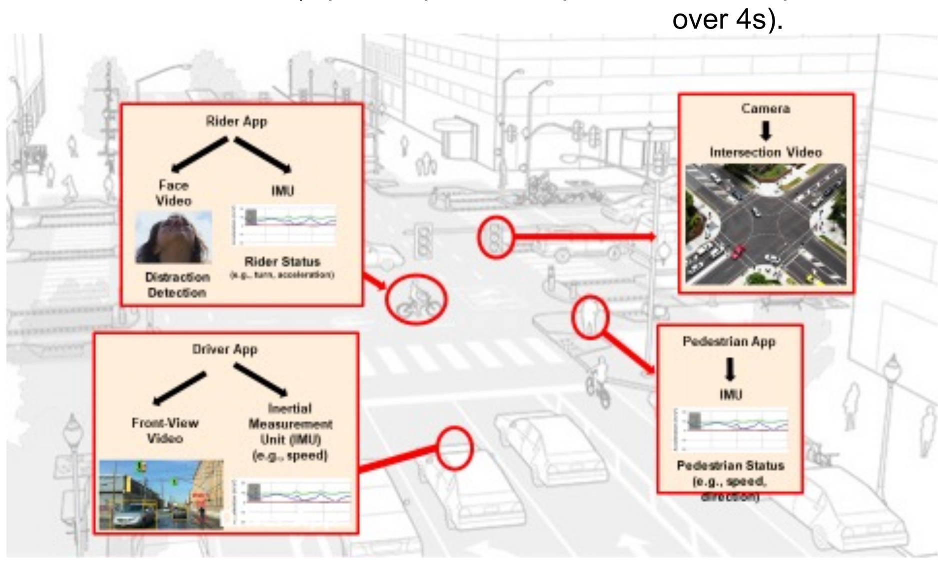
## Technological Experiments

- We are developing a connected app for road users. The goal is to alert users of possible crashes.
- We use machine learning to predict trajectories. Our proposed approach is multiple Ordinary Differential Equations (ODE).



The green line is the ground-truth. The red line is our model's prediction (Input: 10 points sampled from 4s, Output Prediction: 10 more points over 4s).

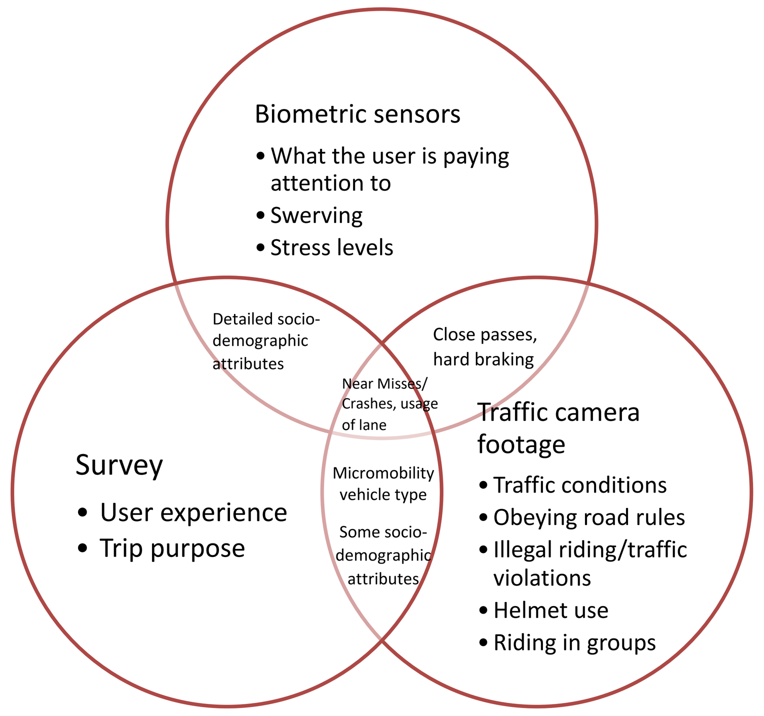


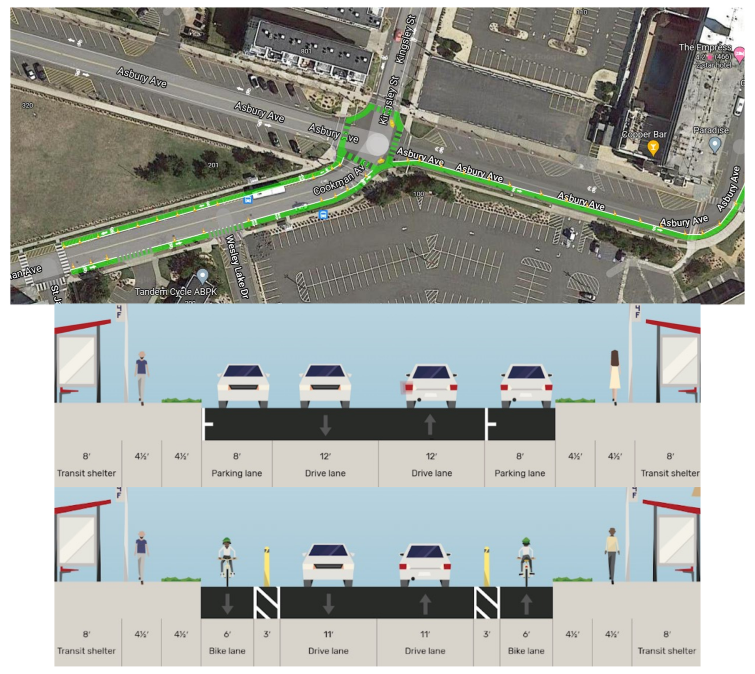

## Smartphone App

- We aim to analyze micro-mobility from a holistic perspective, alerting related users in advance, and ensuring the safety of every user.
- We fuse the data from different sensors (e.g., accelerator, gyroscope, and camera) and apply machine-learning-based methods to analyze the users' maneuvers

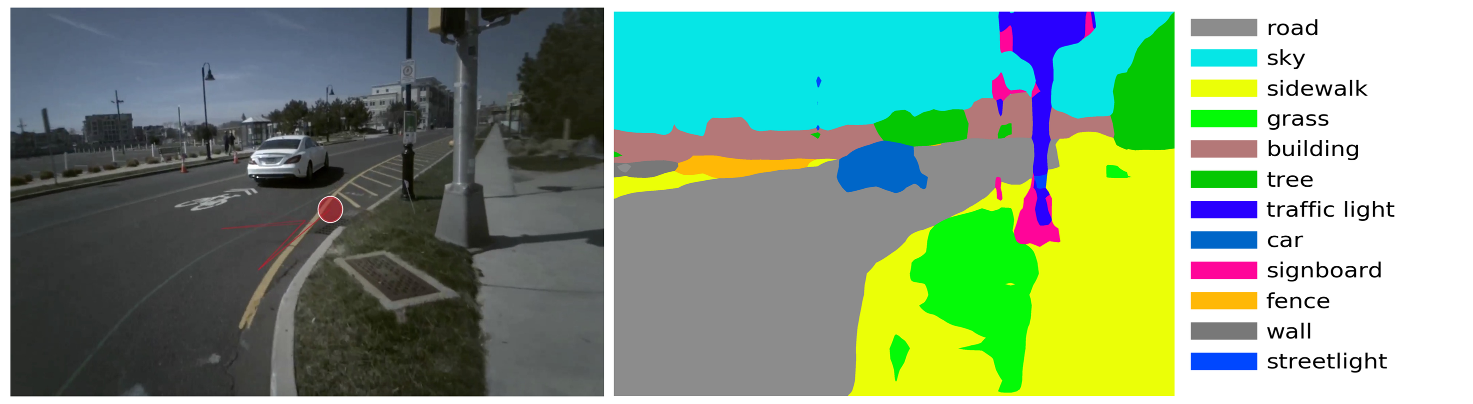
## Social Experiments

- We conducted a tactical urbanism by adding a temporary bicycle lane in the coastal town of Asbury Park, NJ.
- We used surveys, traffic camera footage, and biometric sensors to gauge the safety of the bicycle lane. The Venn Diagram displays the variables that we collected through different methods.



- The biometric sensors, including eye tracking glasses and Galvanic Skin Response (GSR) sensors, were used to gauge the stress levels and cognitive workload of the user.
- The user looked at road and/or traffic related objects around 93% of the time.




(a) Eye tracking glass world-view video, with eye fixation point labeled as the red dot

(b) Image segmentation result using PSPNet.

## Broader Impacts: Technological

- Technological impacts far beyond the particular application to micro-mobility are likely through contributions in geospatial data acquisition, computer vision, and dynamic control of distributed intelligence that harness the data revolution.
- Algorithms for sensor processing, fusion, learning, and visualization, as well as the mobile app—exemplars of growing convergence—will all be released as open-source software.

## Broader Impacts: Societal

- The project directly affects the pedestrian and micromobility experience in NJ, and the tools and deliberate processes developed at these sites should be widely transferable to other jurisdictions.
- Vulnerable elderly, children, and under-represented minority pedestrians and cyclists will benefit because they are currently at disproportionate risk.
- In the long run, we envision that this project will lead to safer roads for all, fewer e-scooter casualties, and better mobility for all as micromobility usage increases.

## Next Steps

- Additional development of trajectory and near-miss models with more video data.
- Development of cell phone apps to provide feedback to non-motorists, including e-scooter users.
- Studio course to evaluate micromobility in New Jersey