# Connected Traffic of Vulnerable Bicyclists and Automated Vehicles

## Deep Learning Trajectory Generation for Realistic Simulated Bicycle Intersection Crossings

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# Connected Traffic of Vulnerable Bicyclists and Automated Vehicles

## Deep Learning Trajectory Generation for Realistic Simulated Bicycle Intersection Crossings

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### Introduction

Worldwide, cities promote cycling due to it's public health and emmission benefits.

Connected Automated Vehicles (AVs) promise to reshape our transport systems.

**Risks:** Conflicting requirements for infrastructure and legislation.

**Chances:** Increased safety and efficiency through collaboration.

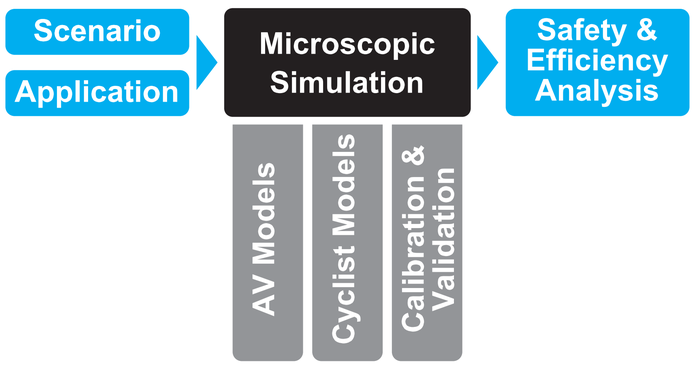
**Knowledge Gap:** How can automated vehicles and cyclists profit from each other?

**Project Goal:** Develop connected bike applications and evaluate safety and efficiency of mixed bike and AV traffic.

### Method

Microscopic traffic simulation enables the analysis of interventions to a traffic system before they are implemented in real life.

Improved road user models and careful calibration with naturalistic cycling and driving data is necessary for realistic simulation.




### Cyclist Simulation

For a meaningful safety assessment with surrogate indicators, cyclist models have to be improved.

Trajectories across road infrastructure and cyclist behaviour around other road users has to be as close to reality as possible.

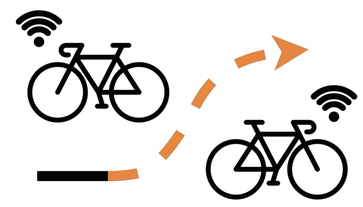
**Proposal:**


Pipeline based on Twaddle et al. (2016) with new tactical, operational and dynamic models.

### How can rider support enhance the safety of connected cyclists?

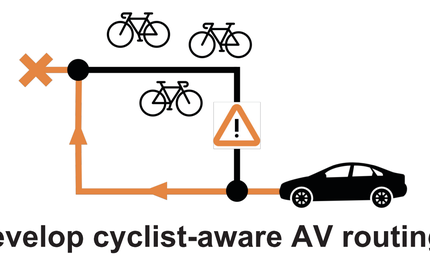
**Develop connected bike applications**


### How can AV trajectory planning profit from connected cyclists?



**Develop connected AV trajectory planning**

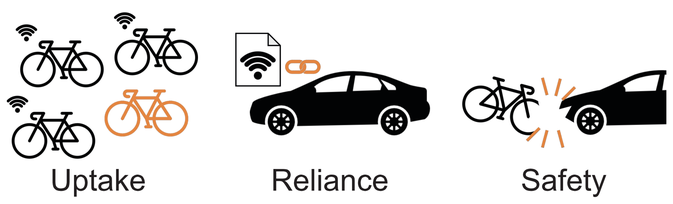
### How can connected cyclists improve AV trip planning?



**Develop cyclist-aware AV routing**

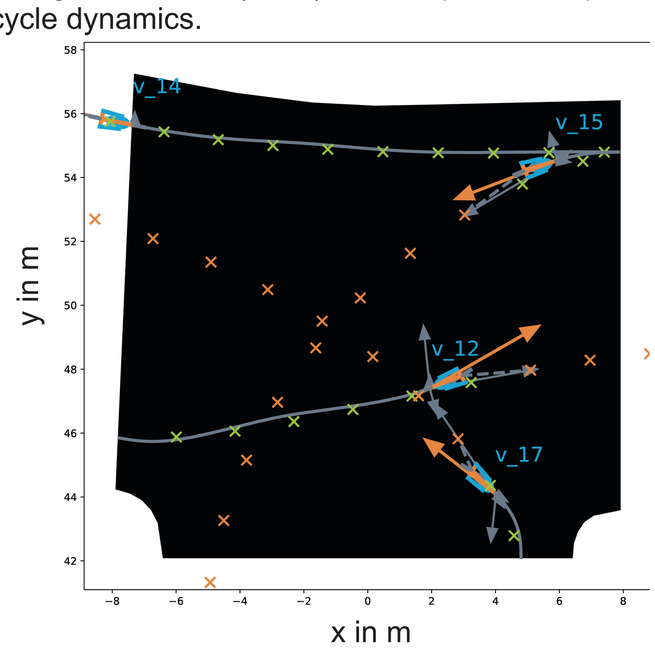
### How does the safety of connected and unconnected road users differ?

**Evaluate trade-off**




### Cyclist Social Force

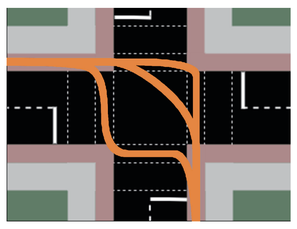
We propose a model for cyclist operational behaviour using social forces. This concept is derived from the pedestrian social force model by Helbing and Molnár (1995) and adapted to respect bicycle dynamics.




### Trajectory Prototype Generation

**Goal:** Model tactical path choice as driving force for cyclist social force model

**Method:** Train a generative neural network based on real trajectories of cyclists on intersections.

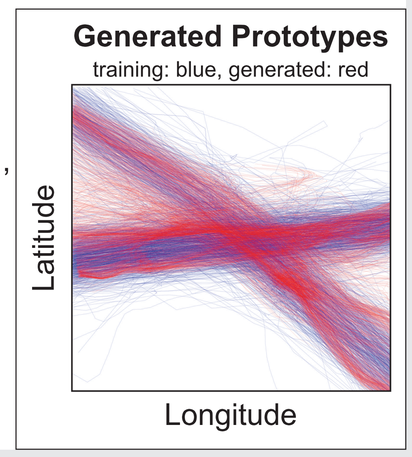


Infrastructure dependend protoypes by layout encoding.

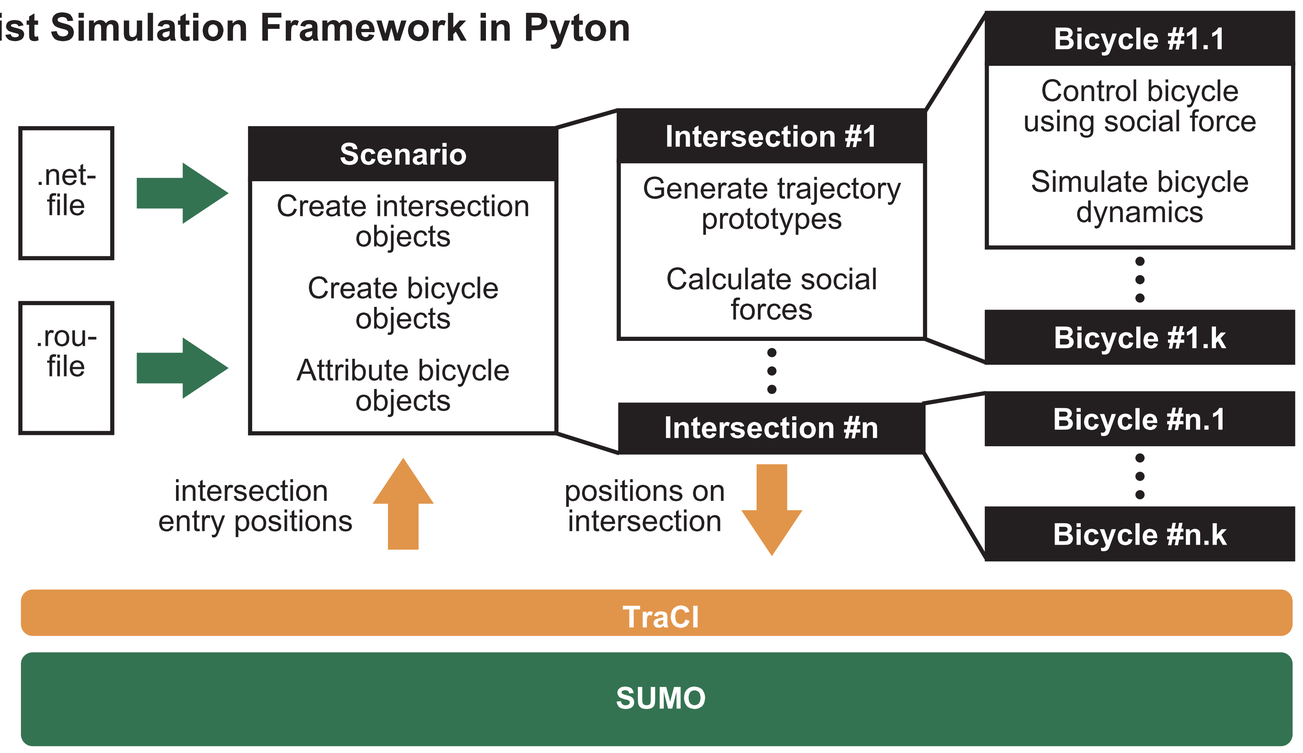
**Current Progress:** Minimal proof of concept - Trajectory generation with TimeGAN (Yoon et al., 2019) based on the SimRa dataset.

1366 training trajectories (blue).

Infrastructure or route not considered yet.




### Cyclist Simulation Framework in Pyton

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