

# BikeZ-ETH: Mass bicycle traffic flow simulation API and cycling trajectory dataset

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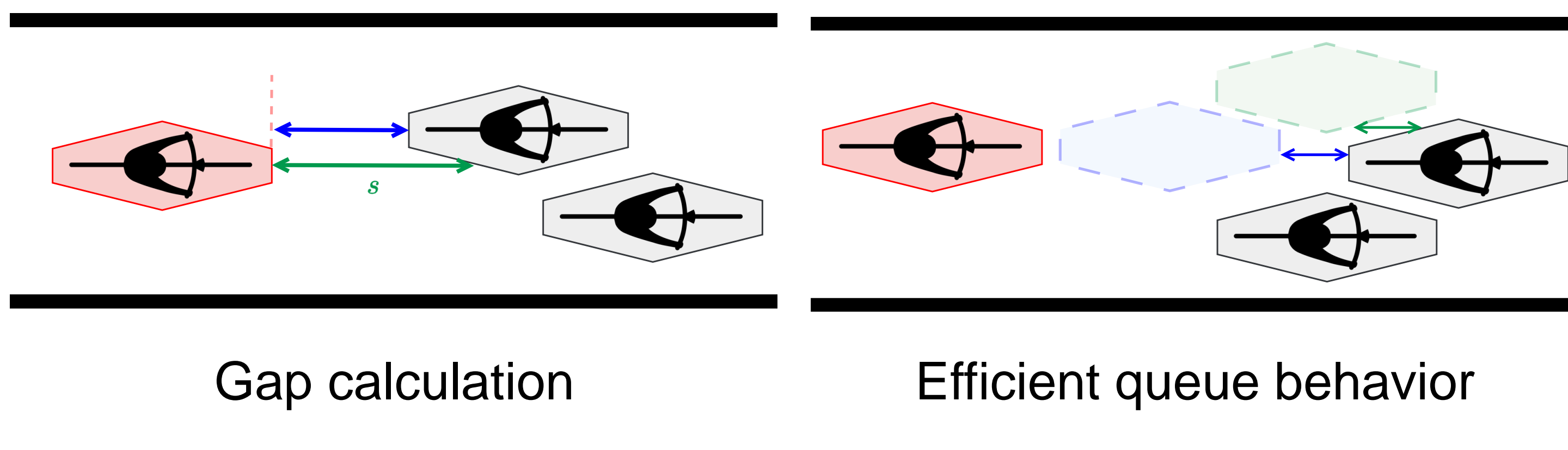
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## Abstract

This study proposes a non-lane-based microscopic bicycle traffic flow model aimed at simulating mass cycling conditions in urban road networks, facilitating the reproduction of realistic bicycle traffic flow congestion dynamics and the evaluation of cycling infrastructure capacity.

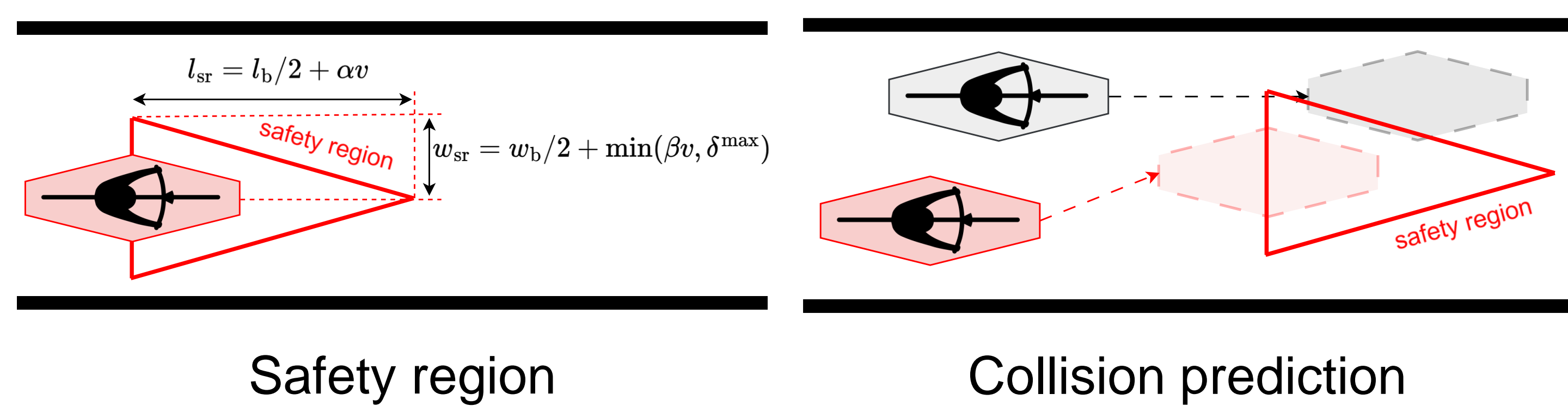
## Bicycle shape & gap calculation

The hexagonal-shaped representation of cyclists and the modified gap calculation function make it easier to simulate congested (high-density) bicycle flow situations and staggered queue formations when queueing.



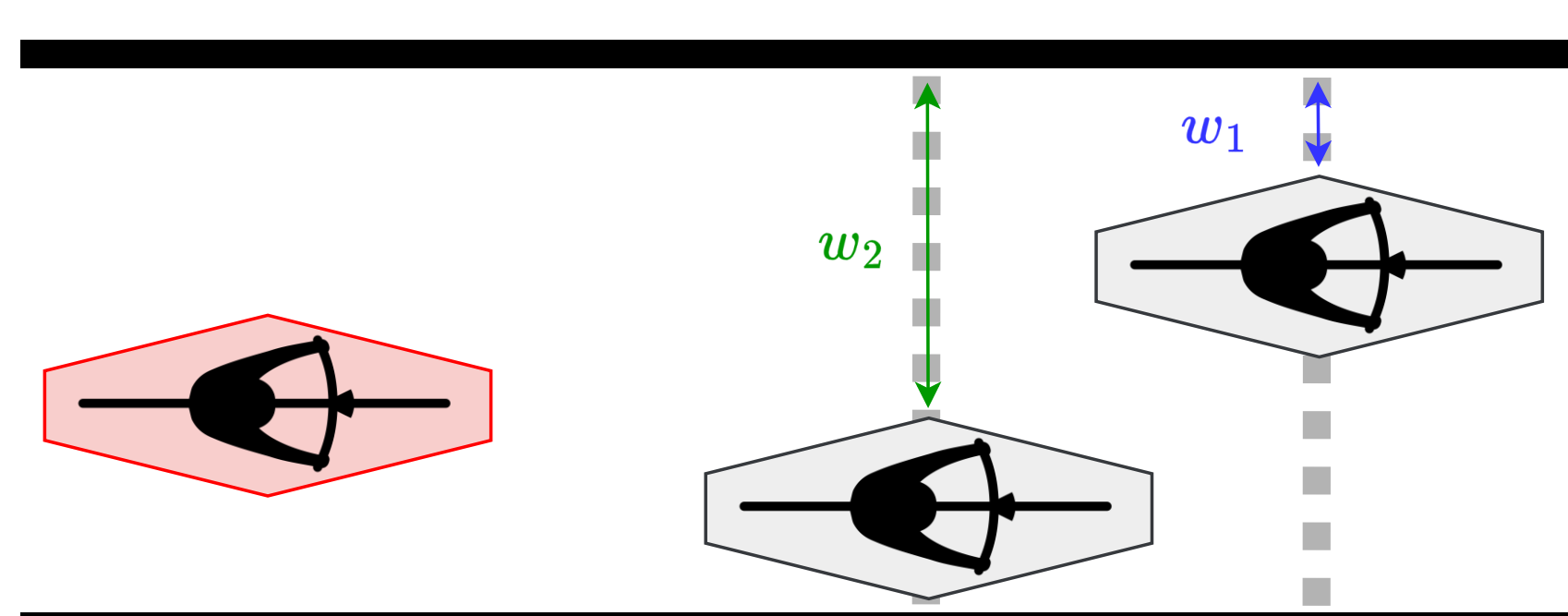
## Safety region & collision-avoidance

The safety region is a triangular area that cyclists tend to keep clear to avoid collision. Its size is influenced by the longitudinal speed. A faster cyclist would require a longer and wider clear space around itself. A non-lane-based collision avoidance mechanism is performed by predicting the future positions of itself and the surrounding cyclists.



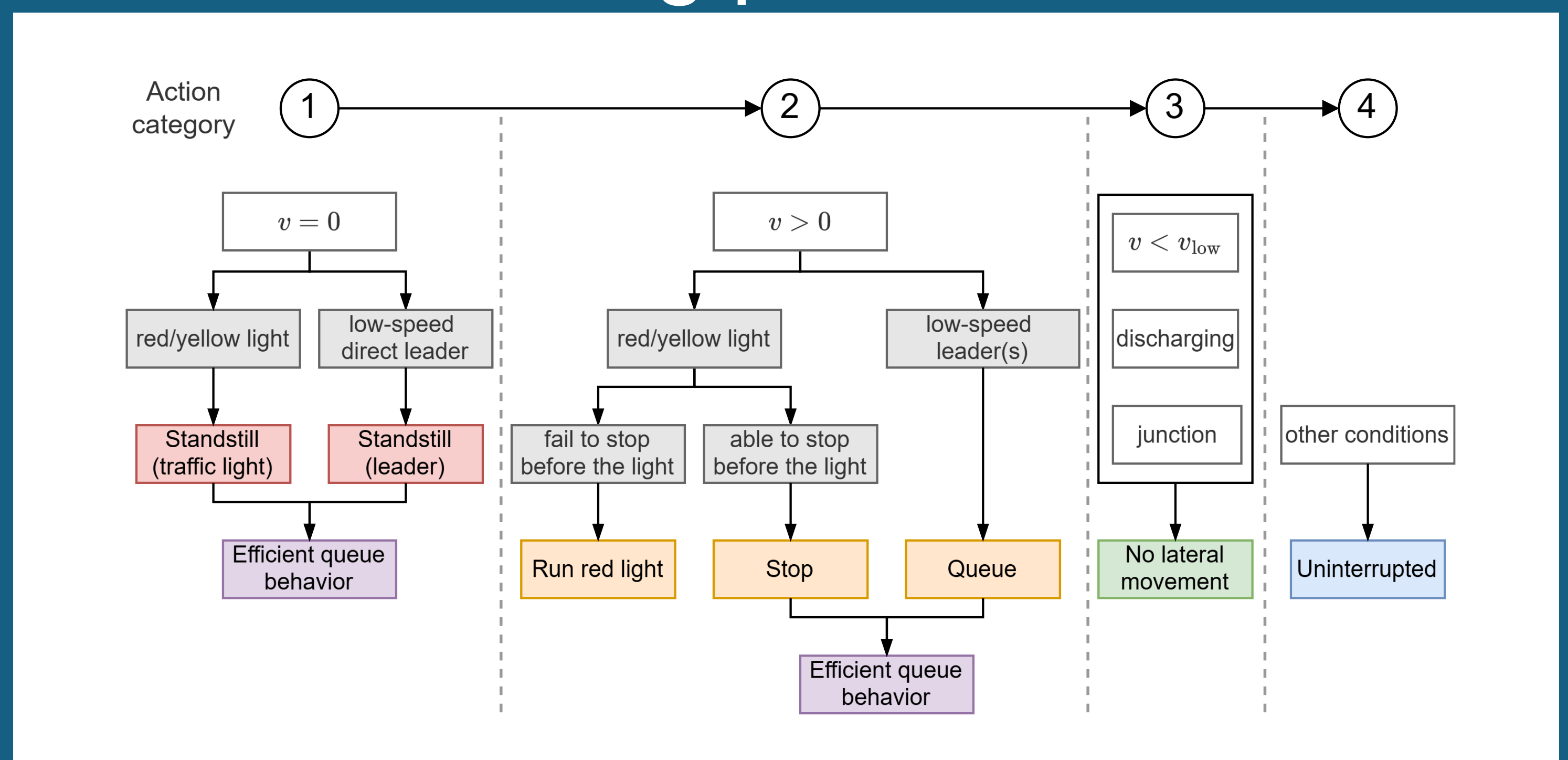
## Overtaking

The ego-cyclist selects the cyclist to be overtaken by checking the farthest available lateral space within its look-ahead distance. The lateral space that is wider than the required width would be chosen. The required width depends on the longitudinal speed of the cyclist that is to be overtaken.



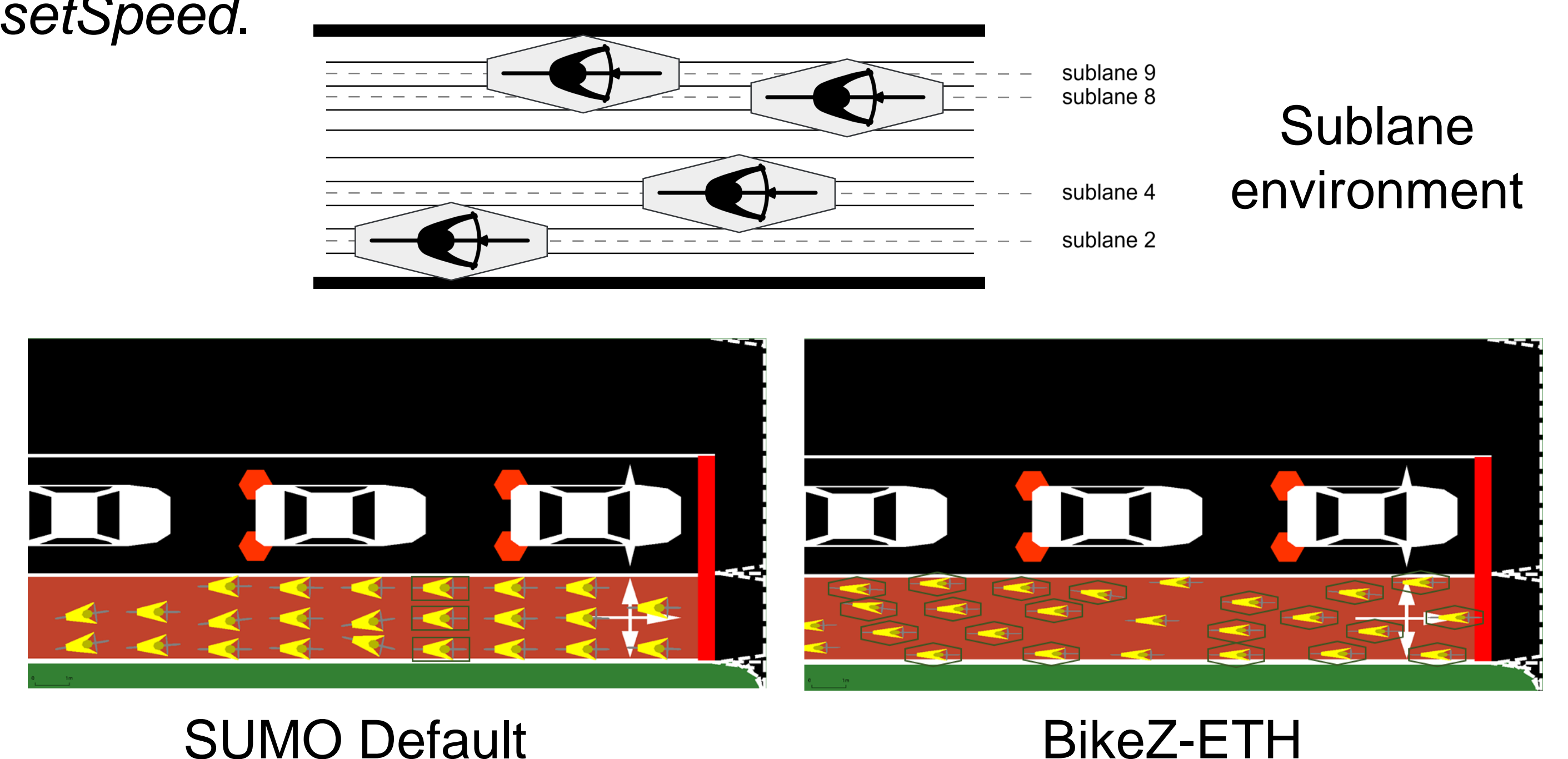
Overtaking lateral space searching behavior

## Decision-making process



## SUMO integration

A dedicated API is developed via TraCI to establish bidirectional communication with the SUMO simulation. At each time step, cyclists' state variables are retrieved, and the behavioral outputs from the model, including **lateral movement distance** and **longitudinal acceleration**, are translated into control actions using *changeSublane* and *setSpeed*.



## BikeZ-ETH dataset

Cycling trajectory data collected via drone-based observations in the BikeZ-ETH dataset will be used for model calibration.

