# Dissipating Stop-And-Go Waves with One Robot: Framework and Details F. Wu, X. Zhai, L. Yu, C. Zhang, Y. Zhou, X. Cao, and A. Bayen November 2019

### **Problem Statement**

To dissipate the stop-and-go waves formed by a group of greedy mobile robots in a circular track by only controlling speed of one robot.

## **Proposed Solution**

• *Decouple*: Slow down to 40% speed limit.

• *Recover*: Once the wave is decoupled, speed up to 60% speed limit.

• Resume: If the gap persists, slowly speed up to until vehicles are evenly spaced or to full speed limit.

#### Implications

 Stop-and-go traffic could be dampened by controlling a few vehicles.

• The control law can be a simple finite state machine.

# **Robotics Framework**



## **Technical Details**

The details of computer vision, vehicle actuation, and communication modules are outlined below.

## **Computer Vision**

 $\rightarrow$  Perspective transform → Background subtraction based on color thresholding  $\rightarrow$  Objection detection using k-means clustering  $\rightarrow$  Data association using nearest neighbor search

# Vehicle Actuation

 $\rightarrow$  Discretize control into five modes, i.e., 0%, 20%, 40%, 60%, 80%, 100% max speed.  $\rightarrow$  A human cooperator selects the mode with a keyboard.

#### Communication

- to ROS



 $\rightarrow$  Establish a local area network  $\rightarrow$  Open a ROS localhost  $\rightarrow$  Publish camera data to ROS → Publish keyboard command

#### → Subscribe vehicle to ROS