Towards traffic junction and traffic flow data acquisition using camera data from drones

Rongjun Qin
Traffic Flow as a Network Analysis Problem

Image courtesy: Linear Algebra – University of buffalo

\[
\begin{align*}
85 + x_4 &= 120 + x_5 \\
85 &= x_1 + x_2 \\
x_1 + x_3 + 45 &=
\end{align*}
\]
Image courtesy: roadtraffic-technology.com and statsmapsnpix
Flow pattern of a single edge

Figure 2-4. Hourly Traffic Flow on the San Francisco-Oakland Bay Bridge

Image courtesy: USDot
Flow pattern of a network

Different level of congestion

Image courtesy: FHWA
Image courtesy: Marino et al, 2017
Understanding the Traffic flow of the Junctions:

1. Provide critical input for traffic network calculation for demand estimation

2. Calibrate simulated model for accurate network analysis (e.g. MATSim – Multi-agent transportation simulation)
Existing methods for accurate traffic data acquisition:

1. Manual Counting
2. Radar Probe
3. GPS crowd sourcing data
4. Probe vehicle
5. Test field
What if we want to analyze the behavior of individual cars, when they stop, how they interact with other vehicles on the road/ in the junction?
Ideas – Using hovering drones to flexibly acquire traffic data of surveying quality using image processing techniques

5 cm accuracy
Drone flying
Building Ground Topography
Potential study scope:

Car tracking

- Speed
- Acceleration
- Response time to pedestrians
- Modeling of drivers’ behavior

Background subtraction
+ segment tracking
Workflow

1. UAV Videos
2. Ortho-rectified Video
3. Identified cars for each frame
4. Trained classifier with training samples
5. Continuously tracked individual cars
6. Individual car behavior analysis and their nest correlations with other cars
7. Ground Topography

Kernelized Correlation Tracker
Deep learning based car tracking
Histogram of speed

DJI_0008.MOV: four-way junction

Histogram of speed

DJI_0003.MOV: three-way junction
Advantages comparing to existing solutions

- Low-cost: Equipment-wise (drones and computer) and labor-wise (1-2 operators)

- Efficiency & convenience: easy mobilizing.

- Data quality: High-precision, high completeness, able to identify different types of cars

- Applicable to mounted surveillance cameras