Motivation

Powered two wheelers (PTWs)
- Motorcycles, Scooters, Mopeds
- Alleviate congestion, reduce travel time…
- Rapidly growing use of PTWs on roads
- The most vulnerable road users

Mixed traffic flow involving PTWs
- Limited knowledge on the interaction of PTWs with other road users
- Classical homogeneous traffic flow models fail to capture the underlying behaviors
- Only few mixed traffic models include moving dynamics of PTWs

Methodology

Macroscopic modeling
- Traffic flow characteristics at macroscopic level

Mixed traffic flow modeling
- Mixed flow of two vehicle classes [PTWs and cars]
- Coupled flow equation for each class

PTWs
\[ \frac{\partial \rho_j (x,t)}{\partial t} + \frac{\partial q_j (x,t)}{\partial x} = 0 \]
where \( \rho = \) density \( q = \) flow \( v = \) speed

Cars
\[ \frac{\partial \rho_j (x,t)}{\partial t} + \frac{\partial q_j (x,t)}{\partial x} = 0 \]

Modeling Speed as function of total density and traffic composition

Approach
- Traffic flow is modeled analogous to fluid flow in porous medium
- Vehicles move through the gaps (pores) between others vehicles
- Pore size distribution represents total density and composition
- Each vehicle class has different critical pore size \( r_c \)

Pore size distribution \( f_p \)
- Poisson point process - vehicles distribution
- Delaunay triangle edge length - pore size
- Vehicles have circular shape

\[ f_p = \frac{1}{\sigma \sqrt{2\pi}} \exp \left( \frac{-x^2}{2\sigma^2} \right) \]

Traffic impacts analysis

- Role of PTWs on traffic congestion and travel time

PTWs unique maneuvering behaviors
- Don’t follow lane discipline
- Filter between lanes of traffic
- Move side by side in the same lane
- Maintain smaller clearance with other vehicles

Lane sharing Filter between lanes

Filtering between stopped cars [Creeping]

Road Capacity (maximum flow rate) at different proportion of the two classes

Results

Model validation
- In congestion state PTWs overtake cars by filtering between lanes

Traffic impacts analysis
- Role of PTWs on traffic congestion and travel time

Traffic time evolution

- PTWs help to maintain smooth traffic flow: less congested and reliable travel time
- PTWs impact aggregate flow behavior and cars traffic

Reference:
1. Sosina Gashaw, Paola Goatin, Jérôme Härrı “Mixed traffic flow with powered two wheelers: macroscopic modeling and analysis“ [To be submitted]