

Motivation

Powered two wheelers (PTWs)

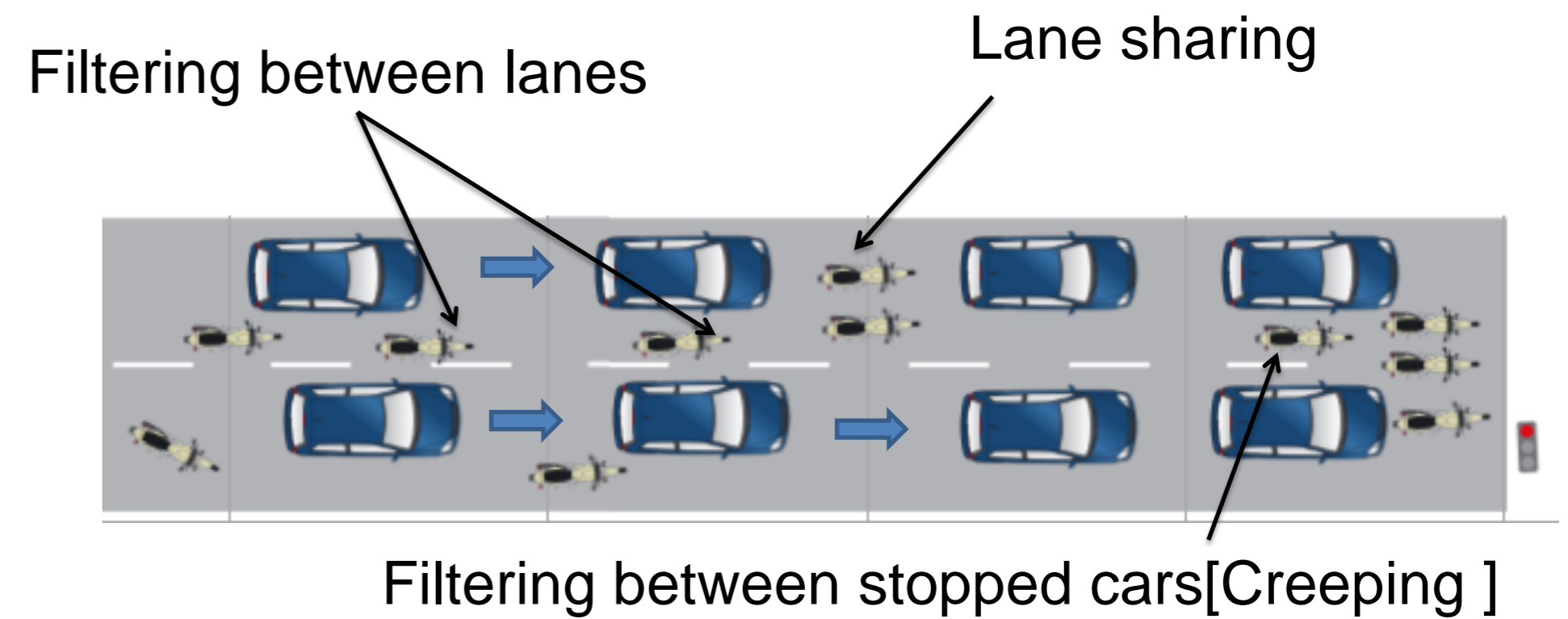
- Motorcycles, Scooters, Mopeds
- Alleviate congestion, reduce travel time...
- Rapidly growing use of PTWs on roads
- The most vulnerable road users

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

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



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

$$\frac{\partial \rho_s(x,t)}{\partial t} + \frac{\partial q_s(x,t)}{\partial x} = 0 \quad q_s(x,t) = \rho_s(x,t)v_s(x,t)$$

Cars

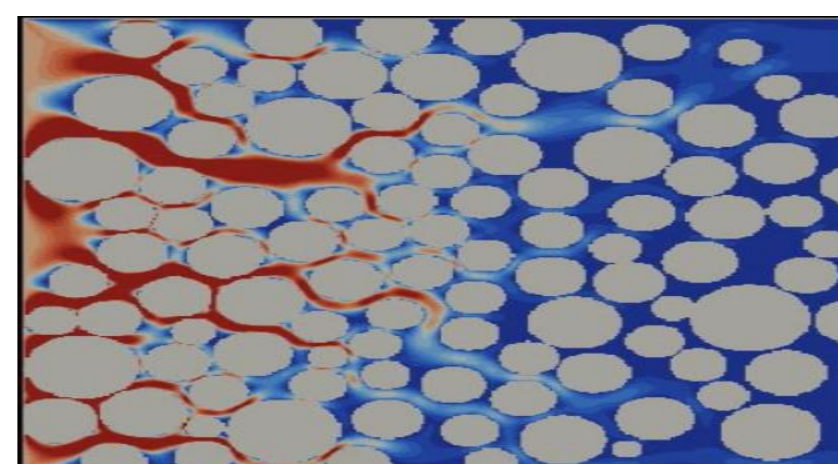
$$\frac{\partial \rho_c(x,t)}{\partial t} + \frac{\partial q_c(x,t)}{\partial x} = 0 \quad q_c(x,t) = \rho_c(x,t)v_c(x,t)$$

Where: ρ =density q =flow v =speed

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^i)



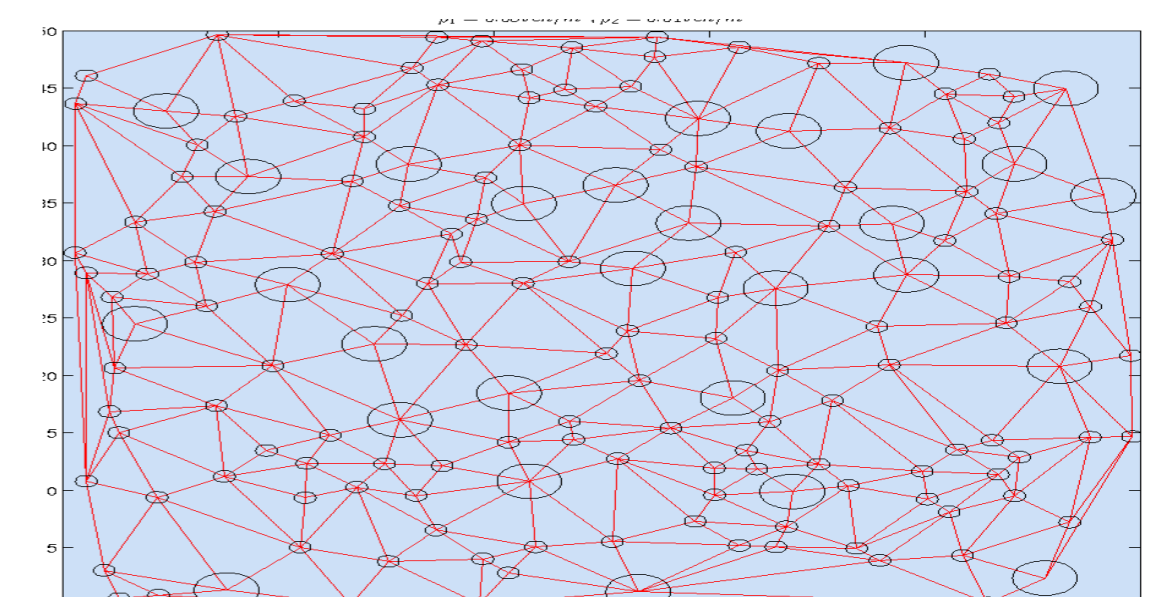
Fluid flow in a porous medium

$$\text{Speed function: } v_i = v_i^f \left(1 - \int_0^{r_c^i} f_p dr\right)$$

Pore size distribution (f_p)

- Poisson point process - vehicles distribution
- Delaunay triangle edge length - pore size
- Vehicles have circular shape

$$f_p = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\lambda)^2}{2\sigma^2}\right) dx$$

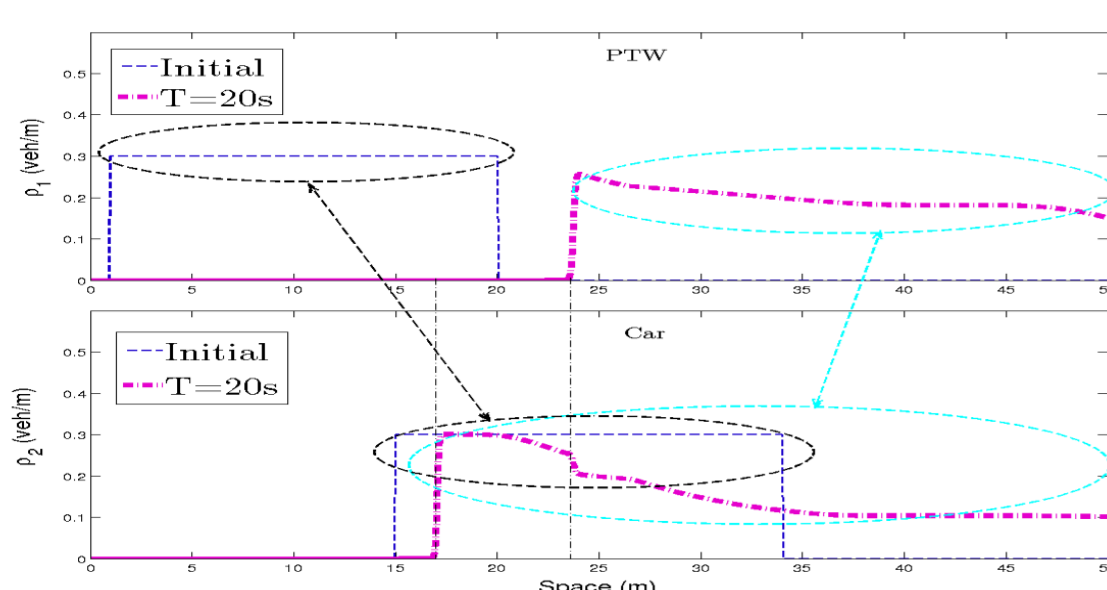


Vehicles in porous flow approach

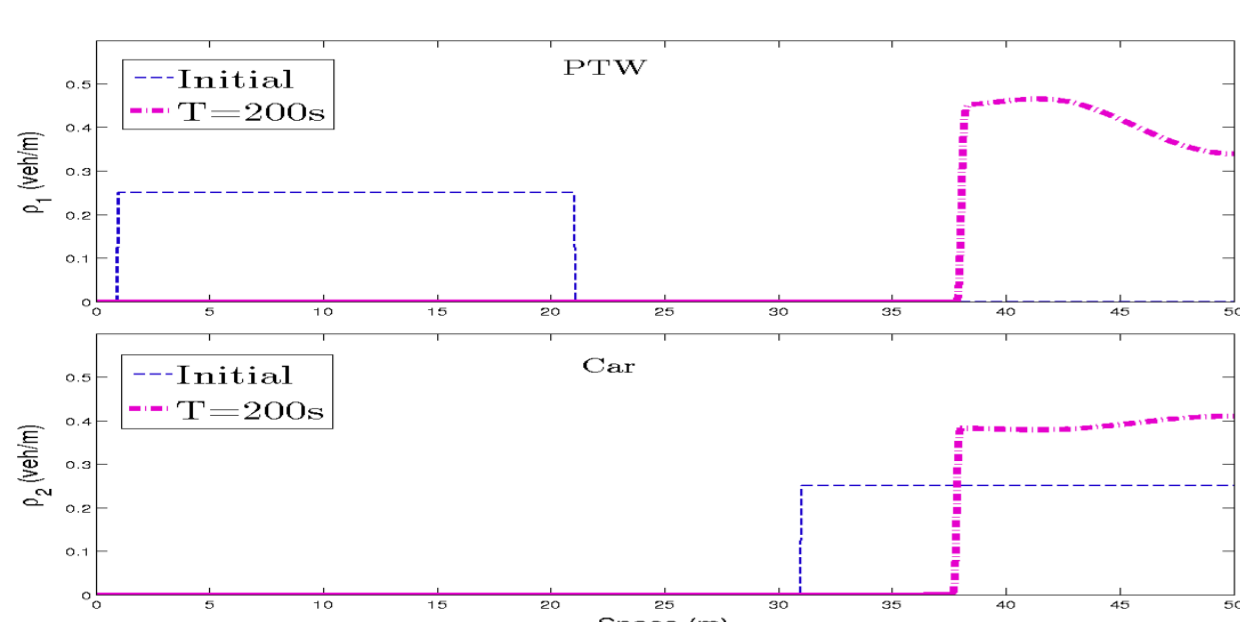
Results

Model validation

- In congestion state PTWs overtake cars by filtering between lanes



- PTWs creep through stationary cars



Traffic impacts analysis

- Role of PTWs on traffic congestion and travel time

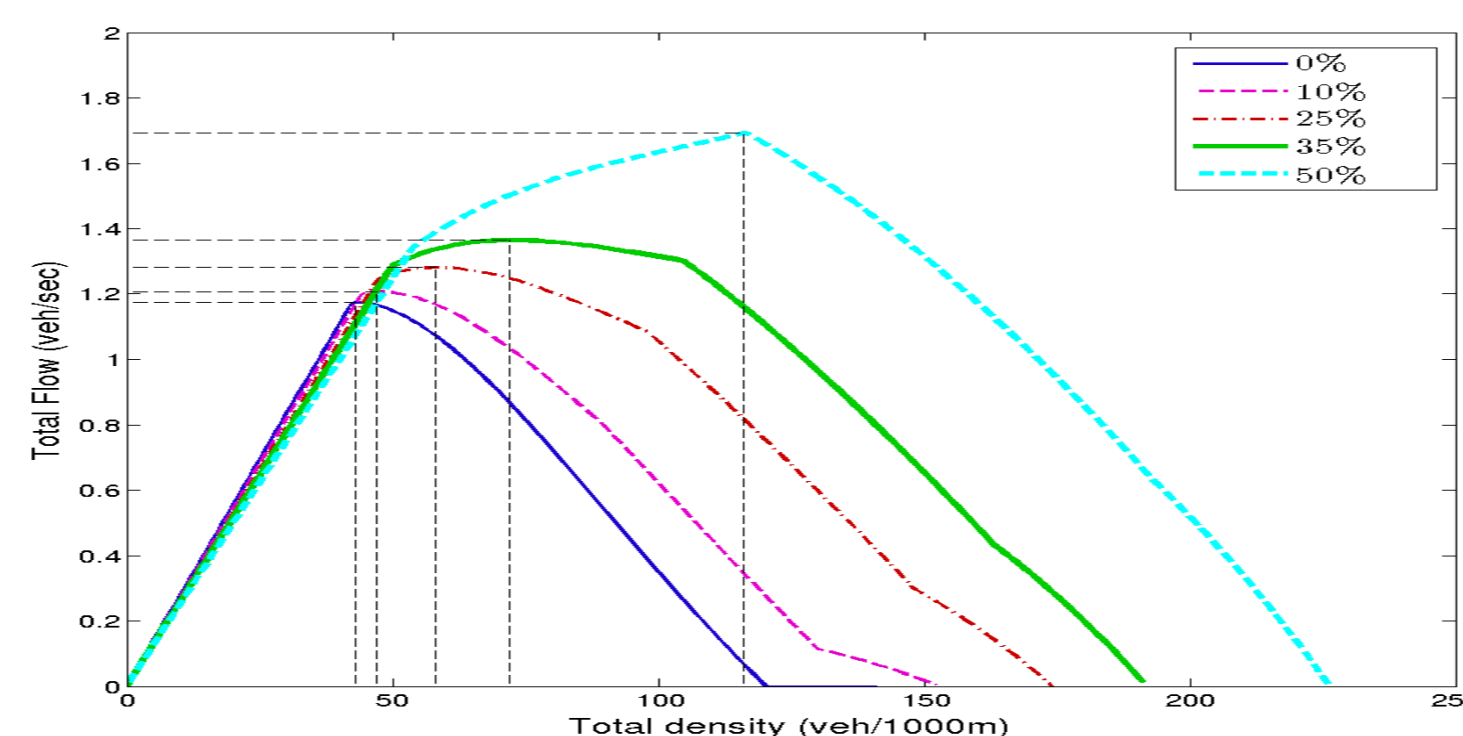


Fig 2 : Flow vs. total density
Road Capacity (maximum flow rate) at different proportion of the two classes

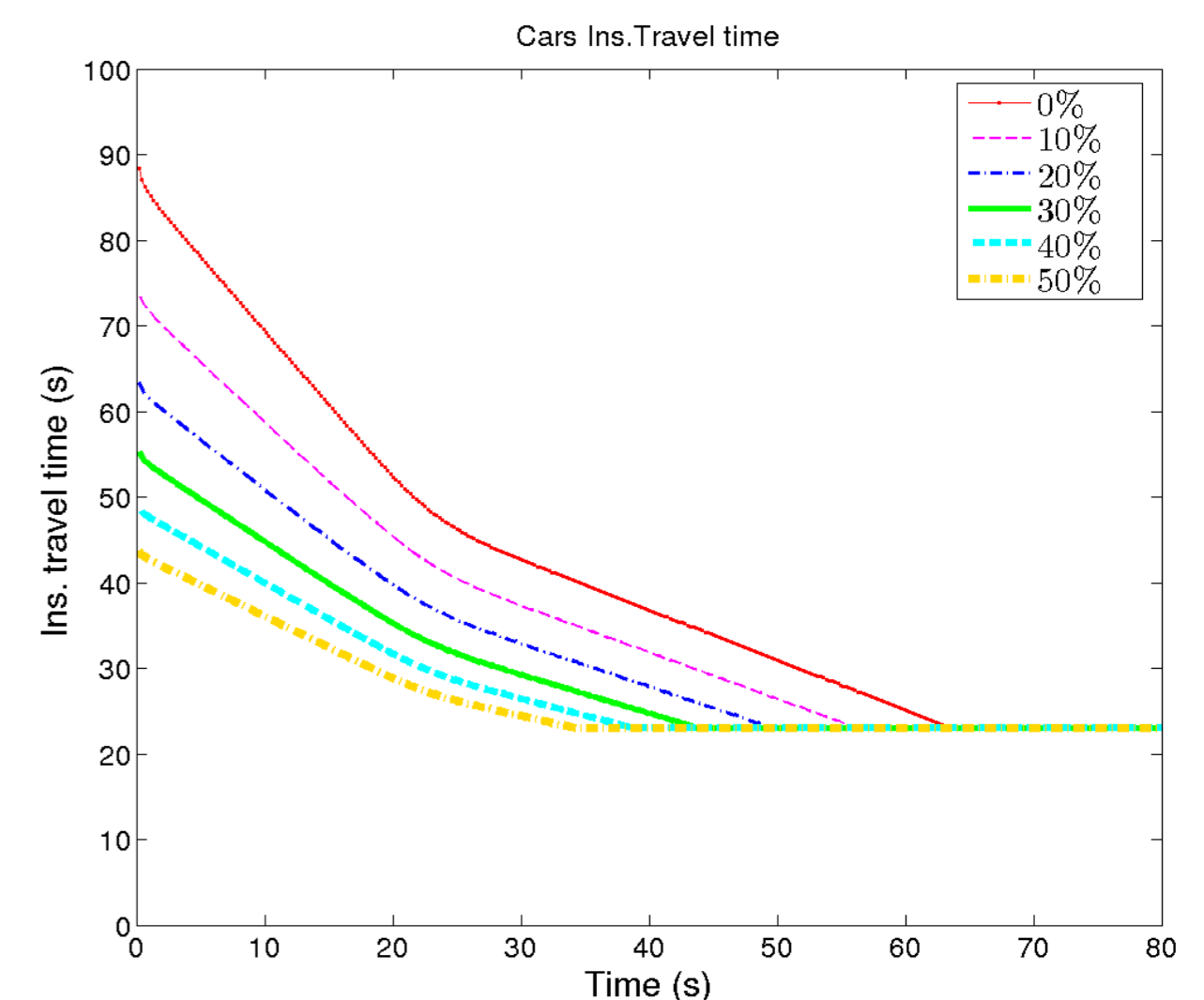


Fig 3 : Travel time evolution

- ✓ 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 Härrri "Mixed traffic flow with powered two wheelers: macroscopic modeling and analysis"[To be submitted]