Matching Parking Supply to Travel Demand towards Sustainability

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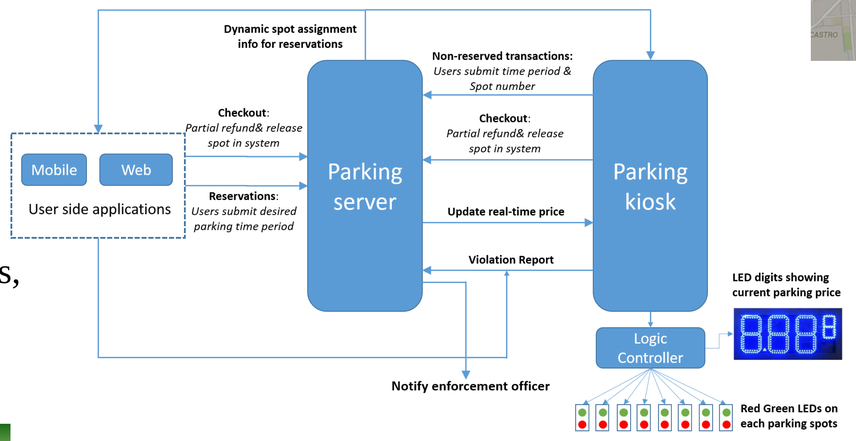
Motivation

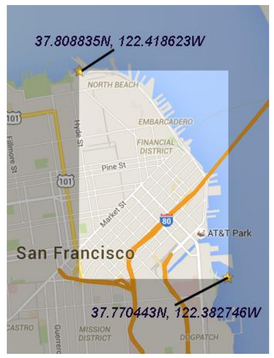
- Parking can considerably influence a traveler's choice of modes, time, and route of travel
- The advent of smart sensors, wireless communication, social media and location based services, and big data analytics offers a unique opportunity to leverage parking for reducing traffic congestion, emissions and fuel consumptions, and enhancing the resilience of transportation infrastructure.
- A cyber physical social system consisting of smart parking sensors, a parking and traffic data repository, parking management systems, and dynamic flow control is proposed, together with the relevant theories, models, and algorithms for modeling travel/parking behavior, and system optimization.

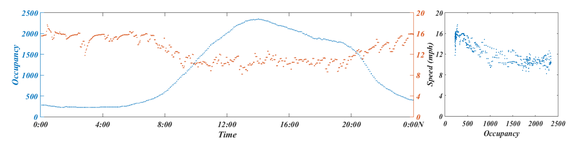
A parking management system

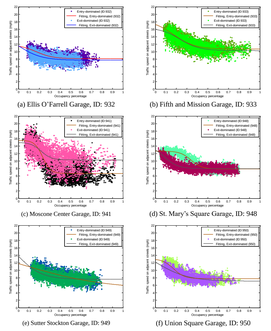
- Easy payment, cheap, effective, reliable
  - Self-reporting systems: non-sensing solution
  - Reservation with a premium fee
  - Dynamic pricing
  - Efficient enforcement
  - Testbed: CMU



Reservoir-based parking/traffic model







Fitting in Logistic curve

$$s(p) = \frac{s_{max} - s_{min}}{1 + e^{k(p-p_c)}} + s_{min}$$

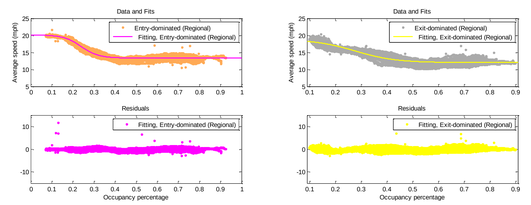
p = percentage of parking occupancy, p ∈ [0,1]

p_c = midpoint of logistic curve

k = steepness of the logistic curve, k > 0

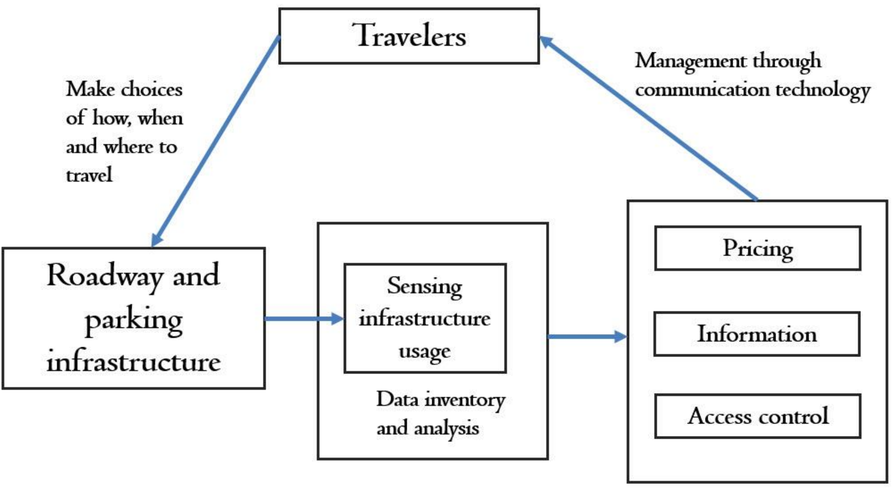
s_{max} = maximum speed

s_{min} = minimum speed



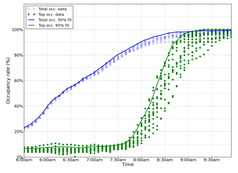
(a) Entry-dominated group (b) Exit-dominated group

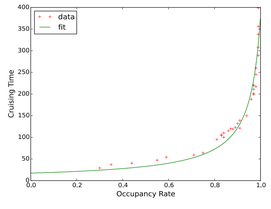
Parking CPS



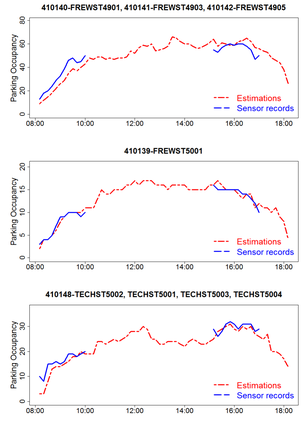
Estimate and predict occupancy

Stanford PS-1

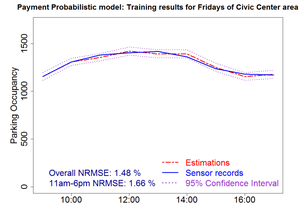


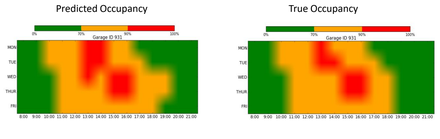


CMU (use meters)

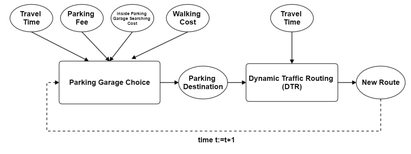


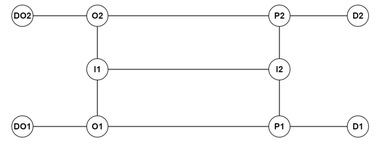
SFPark (use meters)





Parking Search





In low density case, the benefit from dynamic parking and routing guidance system is not substantial.

The benefit becomes significant when the traffic demand is high: Average cost decreases as the percentage of re-routing vehicles increases