Current research
Modeling and control of multi-region and multi-layer cities
• Develop an algorithm to identify **spatially contiguous clusters**
• Accommodate **temporal patterns within the data**
• **Application**: heterogeneous multi-region/layer cities
• Data: Transport; Pollution; Environmental; Population; Weather; Transactions; Incidents; Crime; Education, etc.
• **Functional and temporal clustering**: CDFs are calculated using raw data recorded over space for a period of time
Spatiotemporal clustering: San Francisco, CA

Functional-Distributional clustering with heterogeneous data sets
Venkatasubramaniam, Evers, Ampountolas, IWSM and JSM 2017; under review

https://github.com/AshwiniKV/FdiClust
Multi-region control of mixed bi-modal traffic (cars & buses)

Network clustering

3D-vMFD Center

3D-vMFD Outside

Ampountolas, Zheng, Geroliminis, 2017; TR Part B; 2014 TR Part C
Spatiotemporal clustering: heterogeneous data sets/Scottish Safety Camera Programme

- Reduce the number of casualties on Scotland’s roads by improved driver behaviour
- Network cluster analysis: clusters of car accidents on the road network to identify hotspots
- Where to deploy new cameras?

Scotland, Incident data, 2014
Other application: Housing/Zoopla data London
Control with V2X capabilities: Interconnected networks/Systems of Systems
Decentralised control of interconnected networks

- Design a controller for each subsystem

\[ i \in \mathcal{N} = \{1, 2, \ldots, N\} \]

**Platooning; speed control**

\[ K = \text{diag}(K_1, K_2, \ldots, K_N) \]

Problem

<table>
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<tr>
<th>Off-line Computation</th>
<th>Hardware Embedded</th>
<th>Real-time Control</th>
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\[
J^*(x_0) = \min_{u_i} \left\{ V_N(x_N) + \sum_{i=0}^{N-1} l(x_i, u_i) \right\}
\]

s.t. $x_{i+1} = f(x_i, u_i)$

$(x_i, u_i) \in \mathcal{X} \times \mathcal{U}$

$x_N \in \mathcal{X}_N$

Scialanga and Ampountolas, MFTS 2016; IFAC CTS 2018, under review
Traffic Engineering and Control in the Era of Connected and Automated Vehicles
• Traffic Network -> **Sensors Network** (mobile + static sensors)
• V2V, V2I, H2I Cooperation (on-car/on-site), Smartphones, BT
• **Heterogeneous data sets:**
  – Connected Vehicles; Cellular; Environmental; Transport; Pollution; Environmental; Population; Weather; Transactions; Incidents; Crime; Education, etc.
• In the near future, transport and service delivery are likely to be transformed by **automation, sharing platforms**, and **user-generated heterogeneous data sets**
Can CAV mitigate urban traffic congestion?

- **Road capacity** (time/space headway; speed?)
- **Smooother traffic flow** (air quality; emissions)
- **Interaction** of CAV with conventional veh and pedestrians
- **Safety / Security?**
  (human behaviour contributes by 90% to road incidents)
- **Improved mobility experience** (e.g. people with disabilities)
- **Parking** (cars without drivers can park more closely together!)
- **Economics** (Dial-a-Ride; Mobility as a Service – MaaS/TaaS)

There is plenty of work to be done!
Impact of transport sharing and automation (3 years project)

Potential for increase in kilometres travelled

PTV GROUP

PBA peterbrett

What levels of infrastructure alterations are required, who will provide the investment?

ESRC ECONOMIC & SOCIAL RESEARCH COUNCIL

MaaS Scotland

How will AV’s be programmed to drive?

Who will co-ordinate various ride-share, CAV’s operating systems within a city?

Who will provide the required regulation?

Impact of varying AV rates of penetration across ‘mixed’ traffic
Urban traffic:
Connected environment with V2X capabilities
Motorway traffic: Connected environment with V2X capabilities

- Feedback control for efficient lane management and VSL

- Improving traffic: Cooperative Adaptive Cruise Control (CACC)
Welcome to the UBDC Data Portal

Here you can access a wide range of urban-related data, covering topics such as commercial, governmental, transportation, social media data and more. We will continue to expand the amount of data available, so be sure to check back for future updates.
Glasgow in Motion

Explore where people walk, run, and cycle in Scotland’s largest city.

By 2030, over 90% of the UK population will live in urban areas. It’s more important than ever to understand how we live, work, and travel in our cities. Imagine you could know the most popular cycling route to work, the quality of air on your journey, or how pedestrians respond to weather. Through Glasgow in Motion, you can view and interact with data through time, to better understand movement and other factors that affect Glasgow residents every day.

Thanks for your attention!

Questions?

@Urbanbigdata