Research Challenges in Smart and Connected Communities

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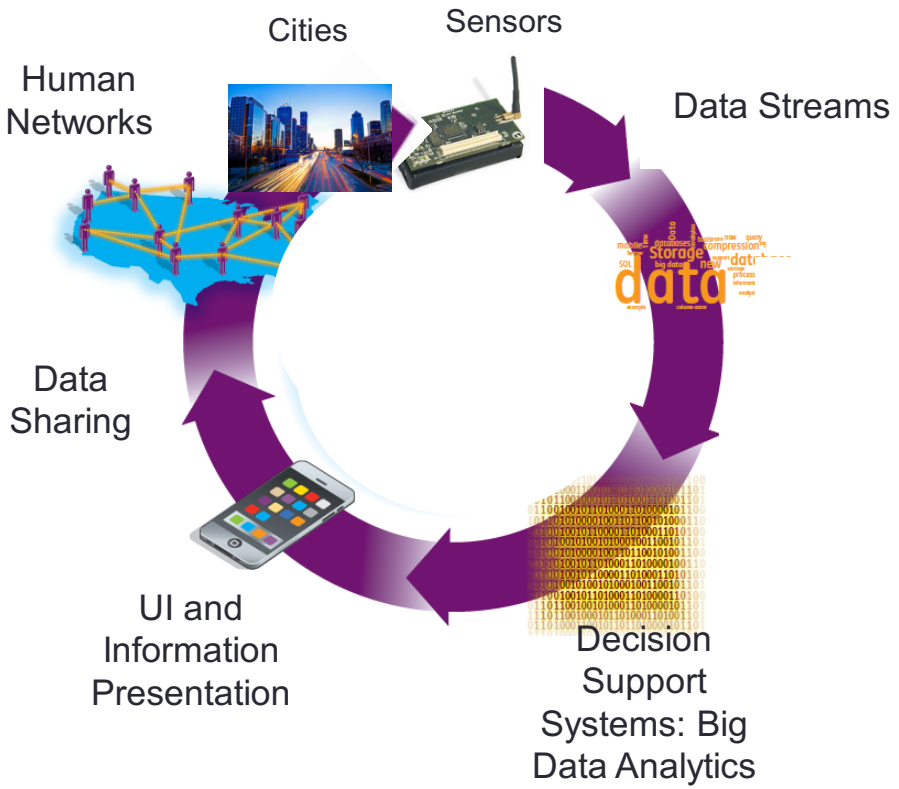


Smart and connected community systems are a feedback loop

- Smart Transportation
- Smart Energy
- Smart Security
- Smart Logistics
- Smart Building
- Smart Health
- Smart Education

- City wide instrumentation
- Handling big data
- Modeling, simulation and a "what-if" machine
- Electrification
- Ride-sharing and "mobility as a service"
- Electric grid integration
- Large scale optimization and control
- Security and safety assurance
- Resiliency

Agenda

1.	Abhishek and Subhadeep	Opening Remarks
2.	Janos Sztipanovits	Understanding the Problem
3.	Dan Work	Challenges and Opportunities of Electrified micro-mobility
4.	Anurag Srivastava	Challenge and solutions with electrification of transportation and electric grid integration
5.	Nalini Venkatasubramanian	Data Collection and Processing: Exploiting mobility to create resilient smart-community services
6.	Lillian Ratliff	Analytics
7.	Sanjay Ranka	Analytics 2 – Video based machine learning for smart traffic intersections and networks
8.	Aranya Chakraborty	Control and Cyber-Security Challenges for Rapid Electric Power Restoration in Coastal Communities After Hurricanes

Understanding the problem

Janos Sztipanovits

- The problem is understanding the societal mechanisms and how the policy and regulation interacts with the cyber-physical dimensions.
- The second problem is understanding the interaction between the domains, for example electrical, transportation and autonomy.
- The presenters shared their views on the challenges and it is clear that there is a pressing need for integrated study of these topics.

Challenges & opportunities for electric micro-mobility

Dan Work

Sperling's "Three revolutions":
- electrified
- connected / automated
- shared

} Dockless micromobility is here, enabled by the three vehicle revolutions

Consequence: the physics of transportation systems are changing.

Efficient micro-mobility potential vs. questionable safety, perils and disruptions

Questions: Are there incentive mechanism for more responsible use
Is there a sweet spot for parking technology and regulation that balances user, operator, and public benefits?

General concern is how the electric sharing vehicles will impact the stability and performance of the city

Challenge and solutions with electrification of transportation and electric grid integration

Anurag Srivastave

Challenge #1: Distribution Grid is designed for one-way power flow
Challenge #2: Accommodating EVs within Existing Grid Capacity
Challenge #3: Utilities can not control EVs
Challenge #4: EVs are mobile and Difficult to do Billing?
Challenge #5: Grid is Driven by Economics and Standard

Opportunity #1: Enabling Resilient Smart Grid
Opportunity # 2: Ancillary Services
Opportunity # 3: Integrated Transportation and Electric Grid Management
Opportunity # 4: Offering Services for Multiple Stakeholders

Can we use and direct EV to support the electric grid as storage and act as ancilliary reserves?

Intelligent Infrastructure & the Digital Transformation: Challenges & Opportunities

Lillian J. Ratliff

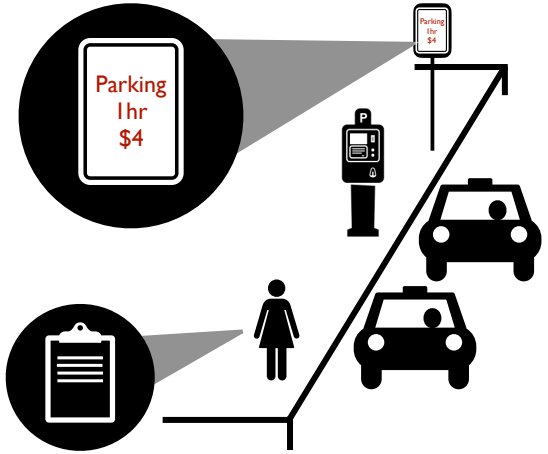
Case Study: on-street/curbside parking

- **Price elasticities** significantly vary spatially and temporally.
- **Location** is the primary driver of parking choice: e.g., in LA study, ~50% of people parked within one block of their intended location.
- **Information** is key: e.g., surveys indicate ~60% of parkers do not know what price they paid

Questions to consider?

- How can we use available data to learn robust representations?
- How can we use modern active learning algorithms to adaptively refine our models?
- What methods can we develop now that will be amenable to technology changes and integration moving forward?

Socially aware algorithms



opportunity?: smart meters + pay-by-phone apps are replacing coin-based, manual meters.

Obtaining data from cities is hard. Parking is an interesting case study.
An extension will be how EV and autonomy will impact parking and the location of charging stations.

Video based machine learning for smart traffic intersections and networks

Sanjay Ranka

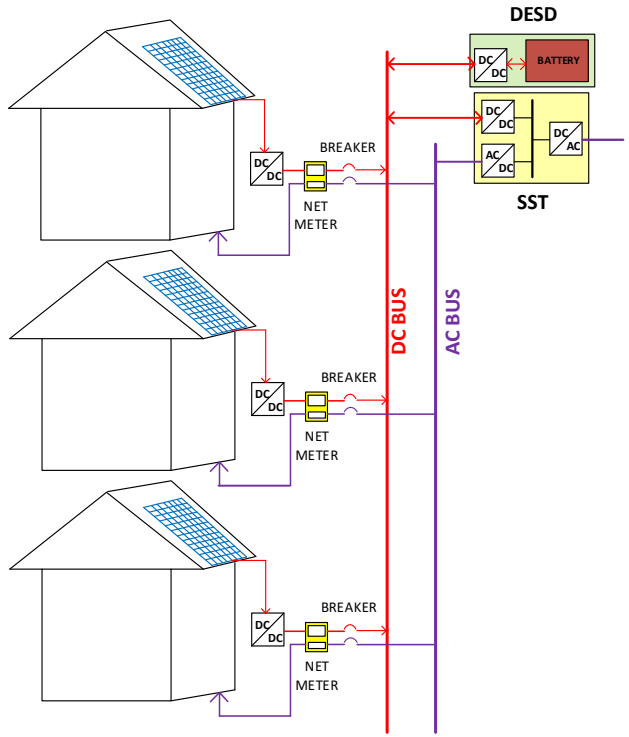
Data can be captured from the city using machine learning to understand demand. This data can then be plugged into the electrical system to understand the integrated impact and requirements.

Infusing Autonomy and Resilience in Power Distribution Systems with Smart Transformers

Aranya Chakrabortty

In 5 more years, shared autonomy

- Control of networked microgrids with SSTs respecting coupling with transportation infrastructure
- Transient Stability
- Power sharing methods in multi-SST system
- Cyber-Physical architecture for control (Use of 5G networks, SDN)
- Plug-and-play operation via retrofitting
- Storage optimization, control, and placement
- Machine learning methods for DR & forecasting of vehicle loads
- Cost-Benefit Analysis and Economics of SSTs



It is critical to develop technology that will allow us to build upon the integration of EV and mobility SST are a way we can start this integration and ensure there is robust interactions

Exploiting Mobility to Enhance Resilience in Community Scale Services

Prof. Nalini Venkatasubramanian

IoT Data Collection Challenges:

- Deployments depend heavily on public infrastructures (e.g. Wi-Fi, power).
- Maintenance is expensive and labor intensive.
- Physical limitations make it hard to deploy uniformly in certain areas

Solution: Combining in-situ and mobile:

Big data is a huge challenge. The sensory information will have to be analyzed in real-time in this integrated city environment. Mobility will impact electricity and electricity prices will impact mobility.