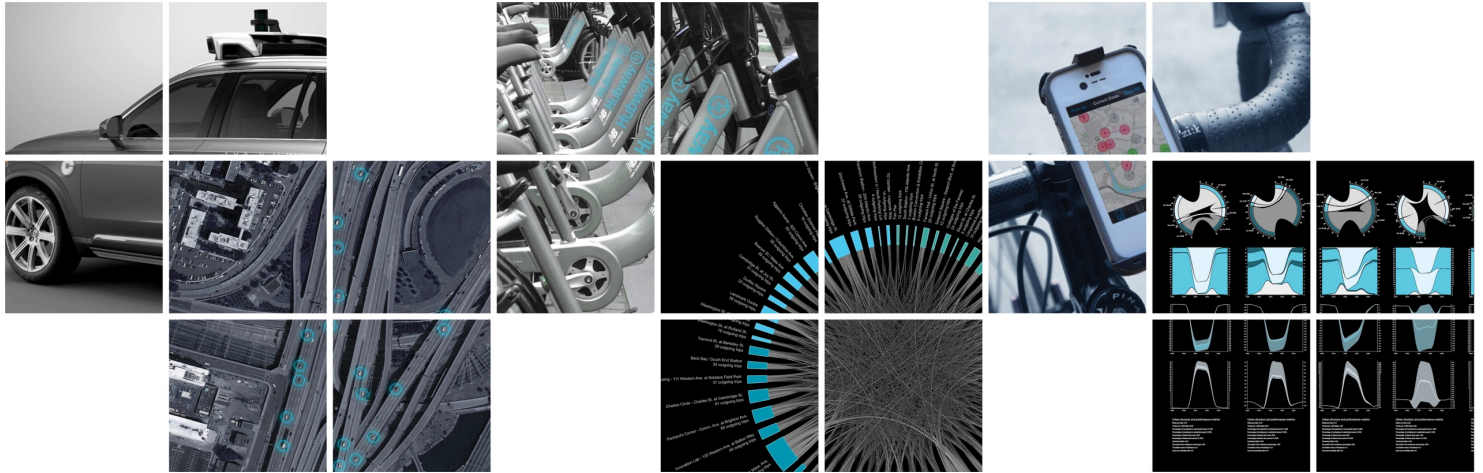# Mobility on Demand Systems: Data-Driven Analysis, Simulation, Visualization

ARCH 6306/6050, MUD 6050, ITIS 8010/6010: Wednesdays evening, Taught Online

Dr. Dimitris Papanikolaou / dpapanik@uncc.edu / Urban Synergetics Lab

PREMISE

Widely considered as the future of sustainable transport with important implications in architecture and city planning, mobility on demand (MoD) systems utilize shared vehicles (bikes, scooters, cars, drones), parking spaces, and advanced information technology, allowing users to move from point to point on demand while cities to reclaim urban land. Yet, opinions on on-demand mobility are controversial. Some studies claim that sharing enhances accessibility while reducing traffic, parking occupation, and dependence on private ownership. Others, however, show that vehicle-miles travelled and congestion increase due to empty trips for rebalancing, pickup, and electric charging. And while some studies advocate autonomous technologies for intelligently distributing fleet at stations, others favor behavioral incentives for that purpose. This seminar introduces advanced topics and fundamental questions of MoD systems focusing on how data-driven analysis, simulation, and visualization techniques in combination with systems thinking can be used to address scenario analysis questions such as: how would traffic, parking availability or carbon emissions change if a portion of private conventional vehicles were replaced by shared autonomous cabs? How might self-organization be induced and under what circumstances can it outperform centralized control?

OBJECTIVES

Provides foundational skills in data-driven analysis, simulation and visualization of MoD systems using System Dynamics (SD) and Agent-Based (AB) approaches. Students will learn: how to find, collect, process, and visualize urban mobility data; how to use data to model and simulate MoD systems; how to develop interactive web-based visualizations using state-of-the-art tools; how to formulate meaningful research/policy questions and how to use interactive simulations, experiments, and visualizations to explore scenarios for addressing them.

TOPICS

Performance and sustainability of MoD systems in relationship to land use and urban form; dynamic pricing, user behavior, and self-organization; Systems Thinking, System Dynamics, Agent Based Systems, Data Visualization, Modeling and Simulation. Covers basic programming skills in JavaScript, D3.JS, P5.JS, LeafLet/Mapbox, NetLogo, and Vensim.

METHOD

Taught online, the seminar combines lectures, case studies, discussions, lab tutorials, in-class experiments, readings, and student presentations, and is organized into team assignments, a final project and a paper. For final projects, students will select a dataset and MoD system of their interest, identify a research or policy problem, develop a model, and use their model to address their problem. Alternatively, students may develop an interactive web-based visualization platform for exploring data for their selected system. Possible datasets include: trip data from bike sharing systems; taxi trip datasets; e-scooter GPS datasets; subway, bus or light rail trip datasets.

PARTICIPATION

Open to students in Planning, Architecture, Data Science (SDS), Software and Information Systems (SIS), and Computer Science (CS).

PREREQUISITES

Prior programming experience is strongly preferred but not required. Willingness to learn coding with various tools is mandatory.

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