FORCES
FOUNDATIONS OF RESILIENT CYBER-PHYSICAL SYSTEMS

Engaging students in CPS Research

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NSF All Hands Meeting, August 23-24, 2017

Berkeley UNIVERSITY OF CALIFORNIA

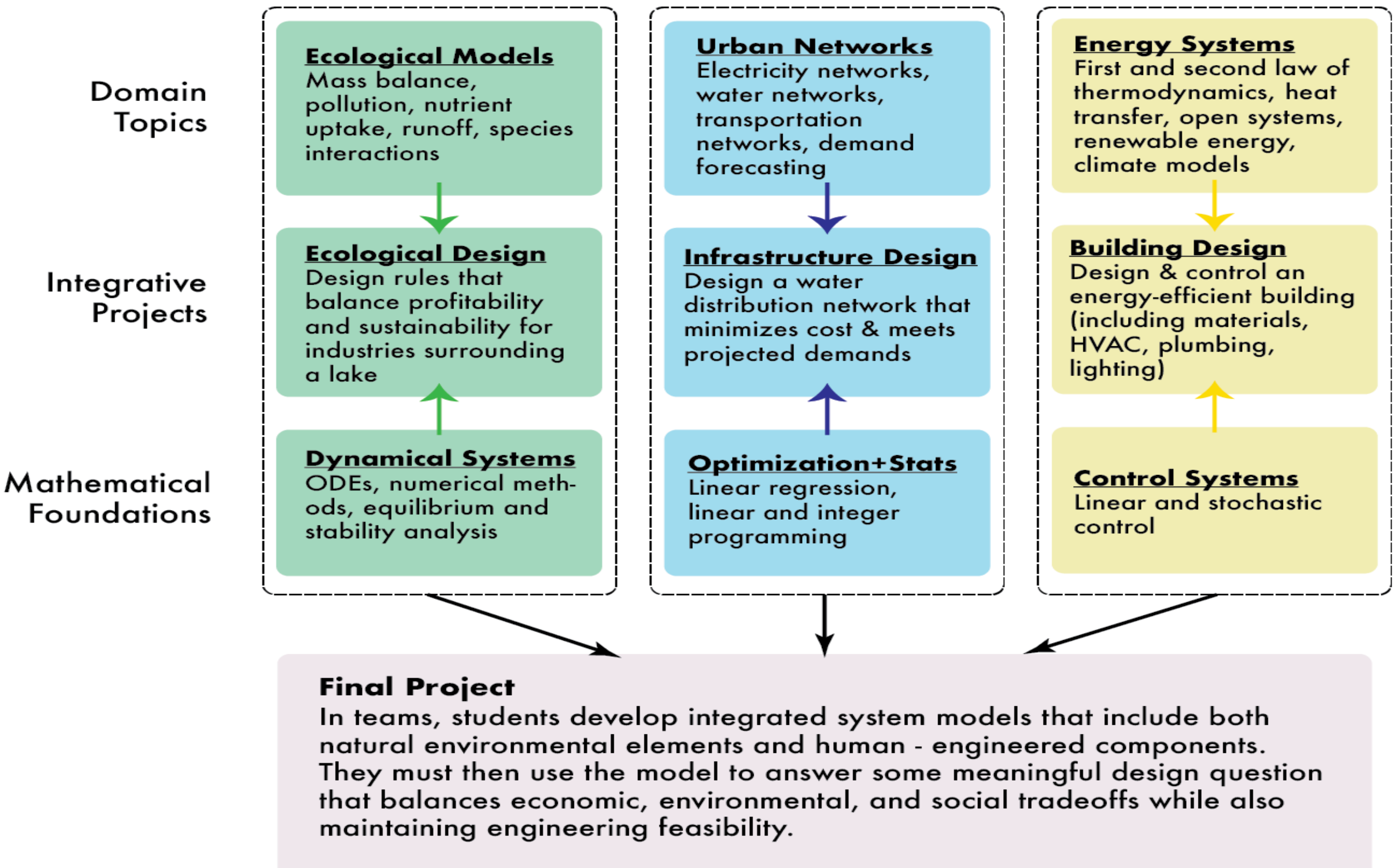
Massachusetts Institute of Technology

NSF

MICHIGAN

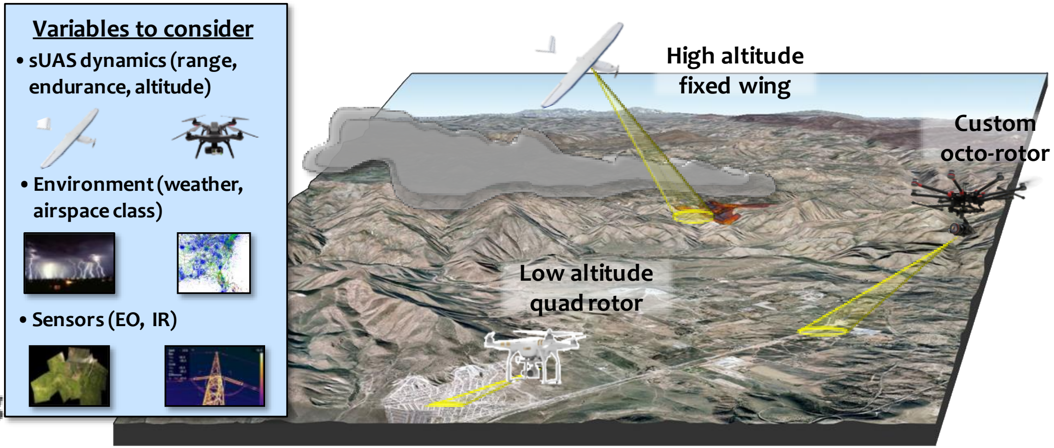
VANDERBILT UNIVERSITY

1. UG Teaching: Engineering Sustainability from CPS viewpoint



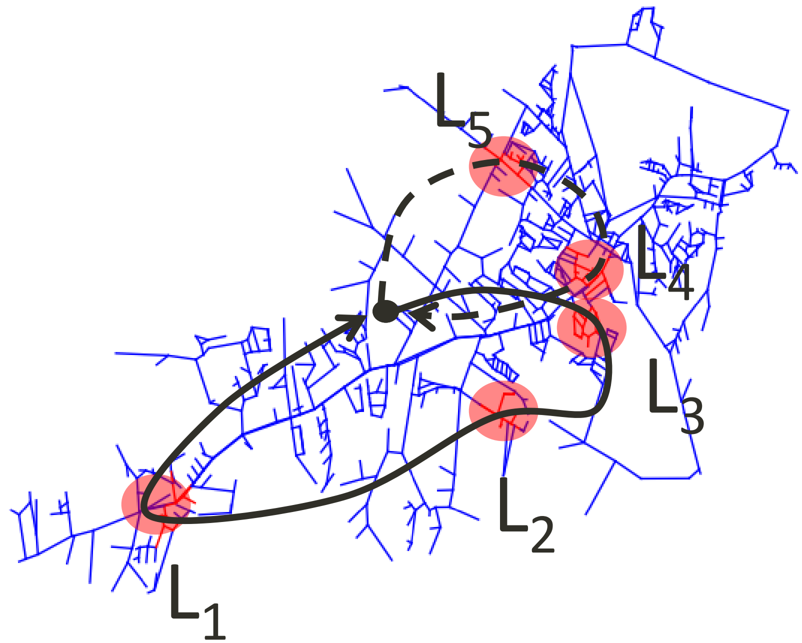
2. Teaching: Capstone project

- Beaver Work capstone project with MIT CEE Department
  - Course 1.013 **CEE Capstone in Spring 2017: B. Bassi and M. Goodson**
  - Support: Lincoln Laboratory and Modern Technologies Solutions, Inc.
  - **Graduate research; UROP projects**
- "Unmanned Aerial System (UAS) Sensor On-Demand" capability
  - System operator: I need sensors here => UAS enable data collection
- Prototype strategic tasker given the environment, sUAS, users, & sensors
  - Integrate sUAS system with mission specific algorithms & systems
  - Intelligent mission planning cognizant of sUAS constraints



3. Spillover to research: Network monitoring under disruptions

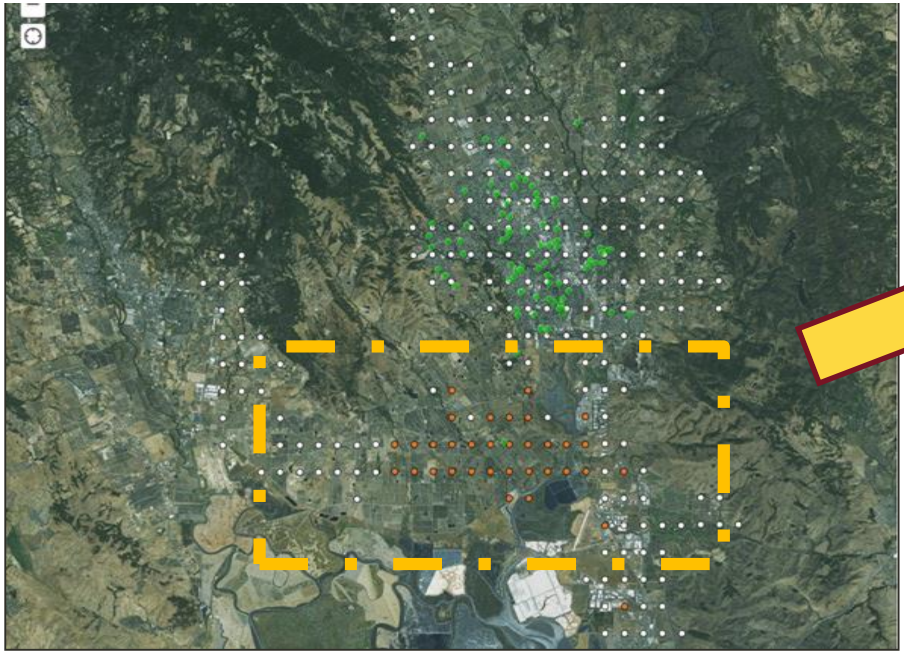
- Disparity exists between ideal monitoring and inspection and current practices for utility networks (e.g., oil and gas).
- Inefficiencies and suboptimal allocation of resources lead to increased cost from losses in the case of failure events.
- Mobile Sensing Systems with small Unmanned Aerial Systems (sUASs) is an opportunity to bridge this gap.



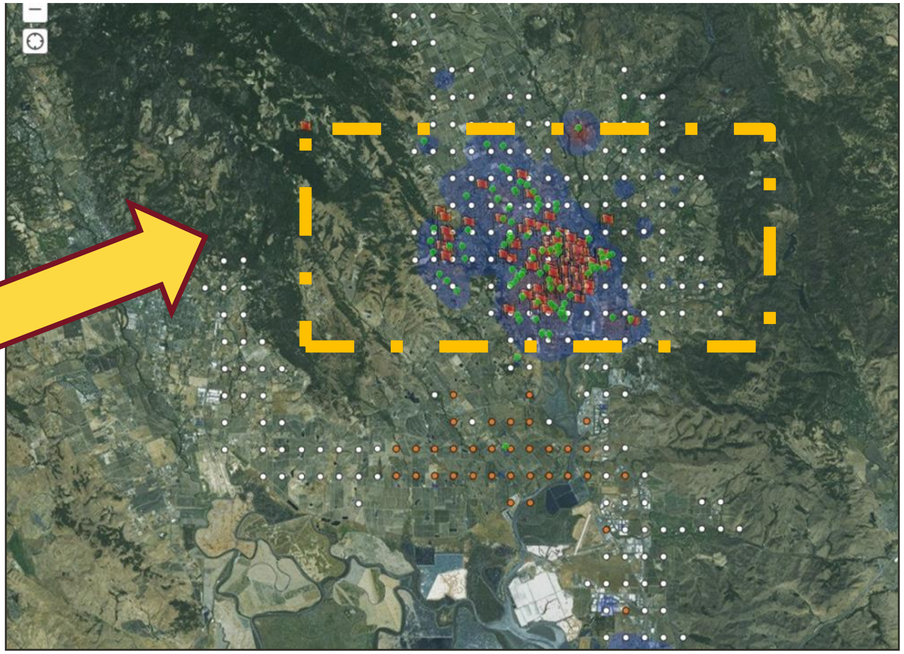
4. Student internships to new research

Problem: Inaccurate Earthquake Damage Prediction

1) DASH Prediction



2) DASH + Additional Variables Prediction



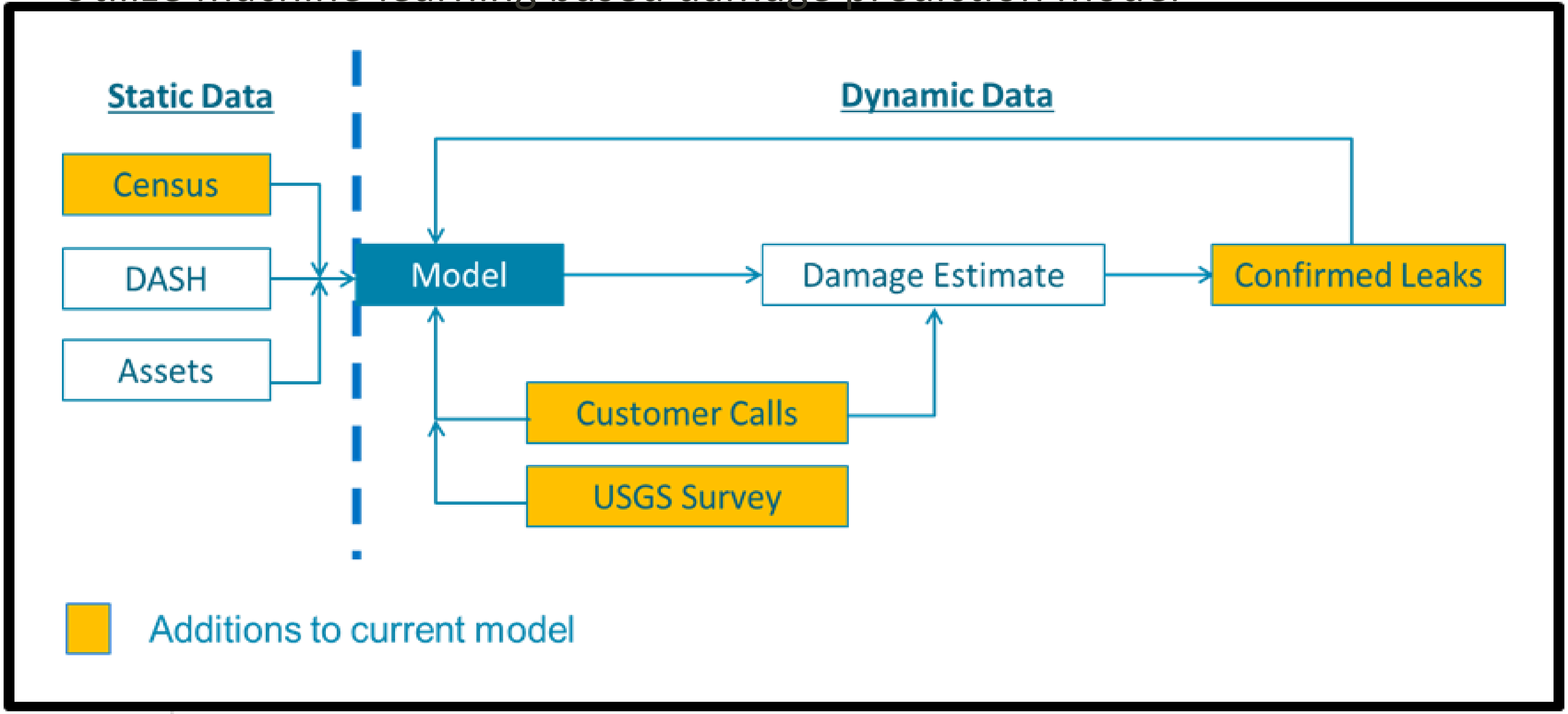
- **White Circles:** DASH damage
- **Orange Circles:** DASH priority areas
- **Green Circles:** Actual leaks

- **Red Flags:** Building damage
- **Purple Coloring:** Location of customer phone calls

*Data from 2014 Napa Earthquake

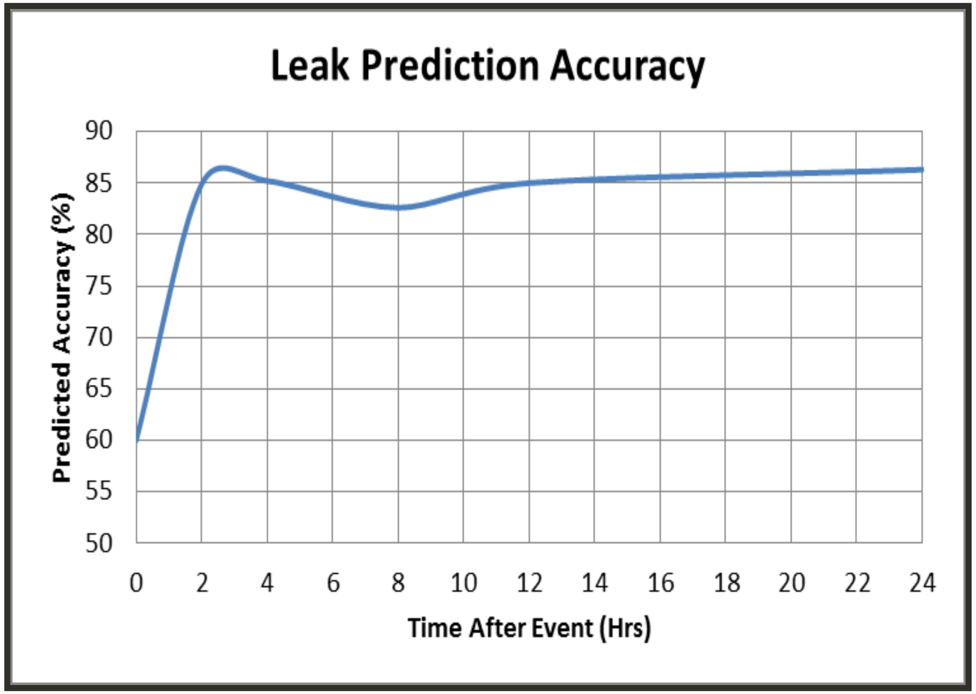
Proposed Solution: Enhance Current Methodology

- Incorporate real-time data
- Account for below and above ground assets, including service lines
- Utilize machine-learning based damage prediction model



Results

- Accuracy improves by over **20% in first 2 hours**
- Output displays the total number of leaks expected per plat as a function of probability



Graph displaying model improvement by using additional variables, updated throughout the event

	Plats	Class0	Class1	Class2	Max
0	2639-H08	0.469501	0.22718	0.30332	Class0
1	2639-I08	0.564764	0.20957	0.225666	Class0
2	2639-J08	0.580021	0.209281	0.210698	Class0
3	2640-H01	0.544185	0.211449	0.244366	Class0
4	2640-I01	0.573376	0.211761	0.214863	Class0
5	2640-J01	0.561382	0.220607	0.21801	Class0
6	2640-J02	0.54376	0.226926	0.229313	Class0
7	2708-I7	0.624345	0.203368	0.172287	Class0
8	2708-I8	0.582381	0.230635	0.186984	Class0
9	2708-J6	0.570355	0.212577	0.217068	Class0

Leak Classes:
Class 0 = (0) Class 1 = (1-5) Class 2 = (6+)