Collaborative Research: CPS: Mutualistic Cyber-Physical Interaction for Self-Adaptive Multi-Damage Monitoring of Civil Infrastructure

Kaijian Liu, Lead PI (Kaijian.Liu@stevens.edu)[‡]; Nora El-Gohary; PI[†]; Vikram Adve, Co-PI [†]; Yi Bao, Co-PI [‡];.
[‡] Stevens Institute of Technology; [†] University of Illinois at Urbana-Champaign

Mutualist Cyber-Physical Interaction

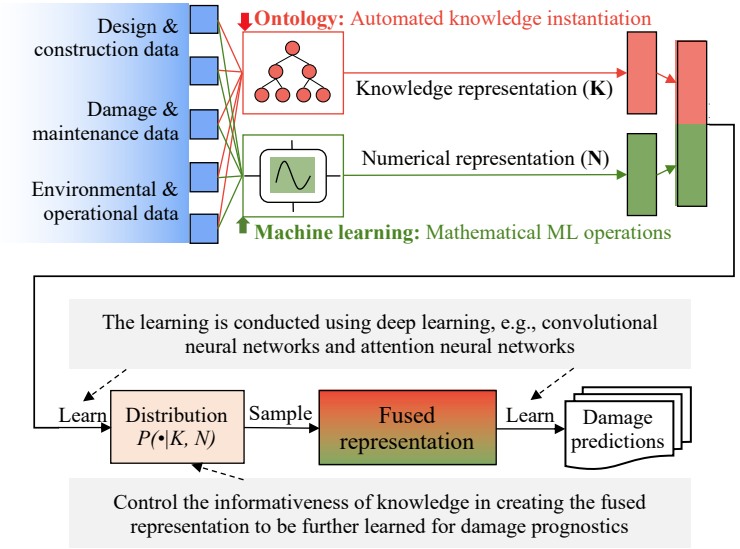
- Predictive analytics & reconfigurable sensing mutually benefit each other
- Improve the ability of CPS to predict, reconfigure, and adapt

CPS Challenges

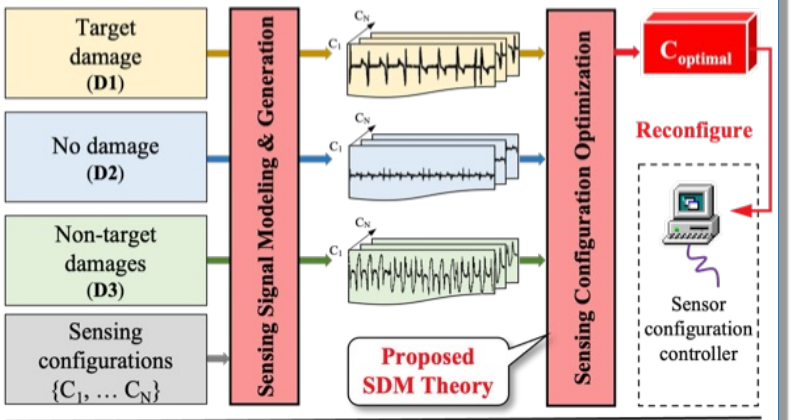
- Generalizable and knowledge-consistent ML
- Adaptive control for reconfigurable sensing
- Efficient and effective information extraction

Proposed Solution

Physics-Informed AI for Damage Prognostics



Adaptive Control of Reconfigurable Sensing



Proposed Signal Difference Maximization (SDM) Theory:
A configuration is optimal to monitor the target damage, if the configuration can amplify the sensing signals for the targe damage to make the signals significantly different from the sensing signals for no and other damages.

Scientific Impact

- Enable self-adaptive, cost-effective infrastructure monitoring
- Offer knowledge-informed ML, sensor reconfiguration, & quality-aware efficiency optimization methods translational to other CPS

Broader Impact

- Cost-effective monitoring for resilient & safe infrastructure
- K-12 engagement & CPS competition projects (2025)
- Deep community and collaborator engagement

Project Collaborators

New Jersey Department of Transportation

New York City DOT

Illinois Department of Transportation

Award Start Date: 08/01/2023

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