# Cyber-Physical Co-Design of Wireless Monitoring and Control for Civil Infrastructure

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The objective of this research is to develop advanced distributed monitoring and control systems for civil infrastructure. The approach uses a cyber-physical co-design of wireless sensor-actuator networks and structural monitoring and control algorithms. The unified cyber-physical system architecture and abstractions employ reusable middleware services to develop hierarchical structural monitoring and control systems.

The intellectual merit of this multi-disciplinary research includes (1) a unified middleware architecture and abstractions for hierarchical sensing and control; (2) a reusable middleware service library for hierarchical structural monitoring and control; (3) customizable time synchronization and synchronized sensing routines; (4) a holistic energy management scheme that maps structural monitoring and control onto a distributed wireless sensor-actuator architecture; (5) dynamic sensor and actuator activation strategies to optimize for the requirements of monitoring, computing, and control; and (6) deployment and empirical validation of structural health monitoring and control systems on representative lab structures and in-service multi-span bridges. While the system constitutes a case study, it will enable the development of general principles that would be applicable to a broad range of engineering cyber-physical systems.

This research will result in a reduction in the lifecycle costs and risks related to our civil infrastructure. The multi-disciplinary team will disseminate results throughout the international research community through open-source software and sensor board hardware. Education and outreach activities will be held in conjunction with the Asia-Pacific Summer School in Smart Structures Technology jointly hosted by the US, Japan, China, and Korea.

This poster will present an overview of the project and on-going research on (1) distributed, multi-level damage detection deployed on a full scale truss, (2) a cyber-physical simulator for wireless structural control combining realistic structural models and wireless networking simulation, (3) a wireless sensor network monitoring a cable-stayed bridge in Korea, and (4) a modular, service-oriented software library for assembling structural health monitoring applications.

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