



## CPS: Breakthrough: Analysis, Identification and Mitigation of Delay Performance

### Bottlenecks of Network Infrastructure in Cyber-Physical Systems

Award #1646458, September 14, 2018 – September 16, 2021 (PI: Liang Cheng, Lehigh University)

Award #2146968, September 17, 2021 – present (PI: Liang Cheng, University of Toledo)

#### Challenge:

- Deterministic performance analysis of cyber-physical systems with random processes
- Scalable identification and adaptive mitigation of network performance bottlenecks in CPS

#### Solution:

- Measurements + network calculus [INFOCOM'19 poster, ICCPS'19 WiP]
- TSN performance monitoring and management system [FlexNets at SIGCOMM'21, ICNP'22]
  - Machine-learning based control
  - Optimized probe path/time

#### Scientific Impact:

- A systematic approach to the design, characterization, and refinement of network infrastructure in CPS
- Non-feedforward network analysis by network calculus

#### Broader Impact:

- Industry practice
  - AFDX: 25% tighter delay bound & 27% more virtual links accommodated [IWQoS'21]
  - TSN-Peeper [ICNP'22]
- Training
  - 11 graduate and undergraduate students
  - 2 survey papers; 1 tutorial at ACM SIGCOMM'19

