Enhancing Cybersecurity of Chemical Process Control Systems

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Graduate Students with Contributions to Work Discussed Below: Henrique Oyama, Kip Nieman, Keshav Kasturi Rangan, Dominic Messina, Akkarakaran Francis Leonard, Jihan Abou Halloun

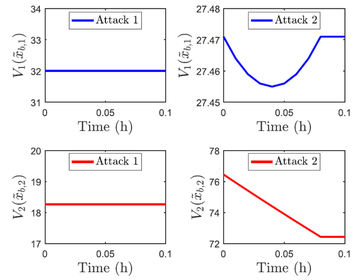
An important challenge for next-generation manufacturing is ensuring that cyberphysical systems developments can be fully utilized without significant restriction in manufacturing capability due to cybersecurity measures and cyberattacks. This requires re-conceptualizing design and control for next-generation manufacturing with security and safety guarantees.

Key Research Challenges:

- One method for handling cyberattacks is to detect them and then perform mitigating actions
  - Potential for cyberattackers to fly under the radar of the detection methodology
  - Need to develop methods for guaranteeing attackers can be detected
  - Such methods may perturb process operation, affecting profits

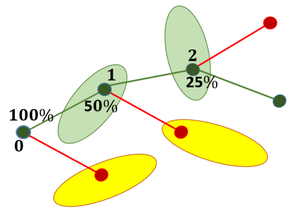
Scientific Impact:

- Analysis and extension of security guarantees
  - Safety guaranteed after undetected sensor attacks if not all sensors attacked
  - Safety potential after all sensors attacked via creating a detection strategy that is challenging to evade by an attacker



Key Research Contributions:

- We are developing rigorous strategies for integrated detection and control that enable attacks to be either detected or ensure some time after detection before a safety issue
- Evaluating how detection policies can theoretically ensure simultaneous cyberattack detection and diagnosis (characterizing the attack as being on actuators versus sensors)



Directed Randomization

- Strategy for randomizing stabilizing control action selection to force a sensor attacker to reveal themselves

Broader Impacts

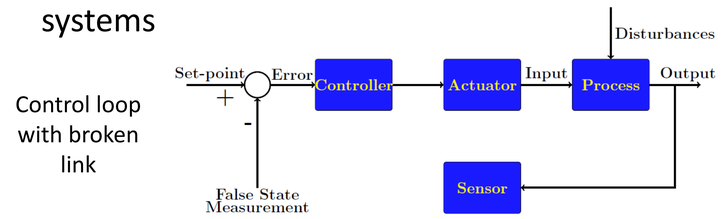
- Potential to streamline next-generation manufacturing, enhancing sustainability and American industry
- Undergraduate students trained in REU experience
- Contributed to training for 8 graduate students
- Metro Detroit Youth Day and C2 Pipeline Summer Camps
- Animated short to YouTube

Student Achievements

- Inclusion of work related to this grant in PhD thesis of Henrique Oyama
- Fostering undergraduate interest in research and providing opportunities for trying it
- Undergraduate researcher awarded second place out of four in the Student Technical Presentation Competition at the AIChE North-Central Regional Conference in 2021

Broader Impacts

- Broad relevance to critical industries and infrastructure
- Results developed broadly for nonlinear systems



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