CAREER: Synthesis and Control of Cyber-Resilient CPS

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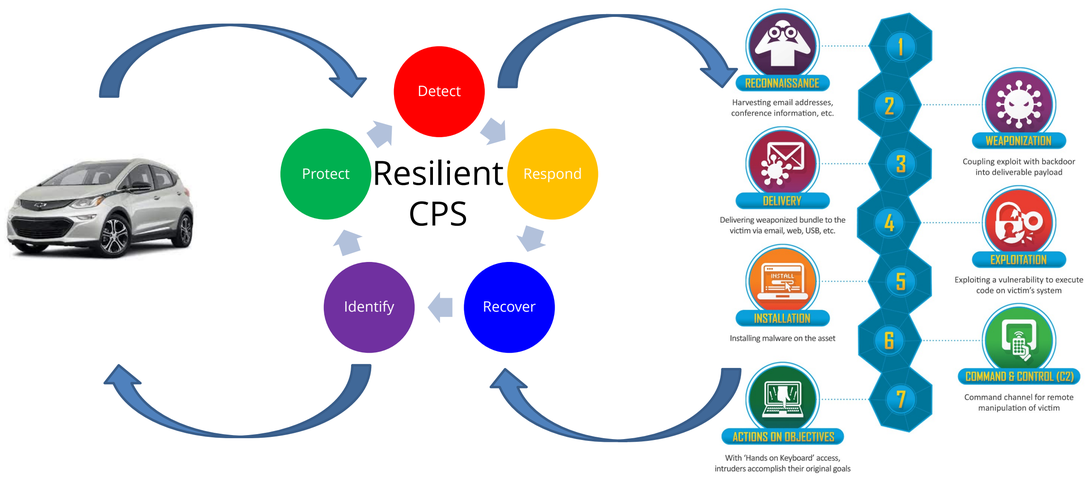
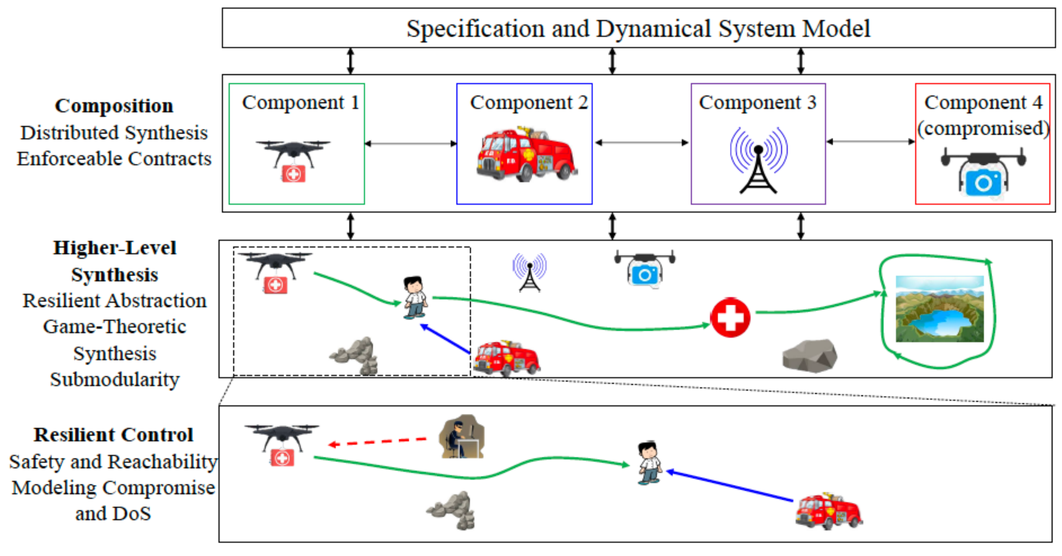
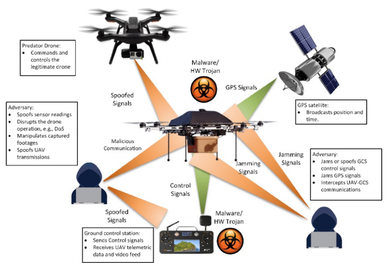




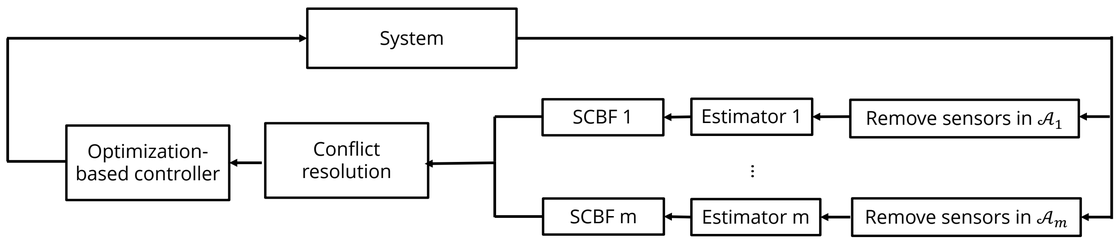
Challenges

- CPS targeted by malicious attacks
- Large attack surface
- Must satisfy safety and performance requirements during and after attacks



Scientific Impact

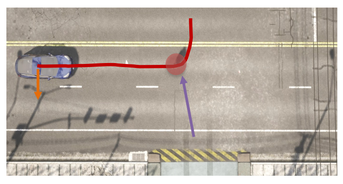
- Algorithms for safety and performance under malicious attacks
- Scalable verification of safety and resilience
- Modeling impact of cyber attacks on complex specifications (liveness, task



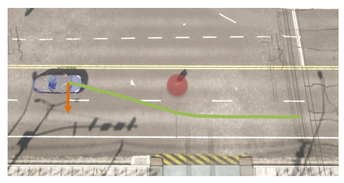
Solutions

- Resilient Control Barrier and Lyapunov Functions for safety and stability
- Algebraic-geometric framework for safety verification
- Verifiable safety under Lidar spoofing

- Discretization-free synthesis to satisfy task specifications
- Safe and resilient learning algorithms



Sensor attack



Proposed safe control

Impact on application domains:

- Autonomous vehicles: Safety under sensor attacks
- Industrial control systems: Resilience to system compromise and malware

Education and Outreach:

- Undergraduate summer research mentoring
- Public outreach

References:

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[3] H. Zhang, J. Wu, Y. Vorobeychik, and A. Clark, "Exact Verification of ReLU Neural Control Barrier Functions." Advances in Neural Information Processing Systems (NeurIPS), 2023.

[4] L. Niu, Z. Li, and A. Clark, "Abstraction-Free Control Synthesis to Satisfy Temporal Logic Constraints under Sensor Faults and Attacks." IEEE Conference on Decision and Control (CDC), 2022.

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[7] A. Clark, "Verification and Synthesis of Control Barrier Functions." IEEE Conference on Decision and Control (CDC), 2021.

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