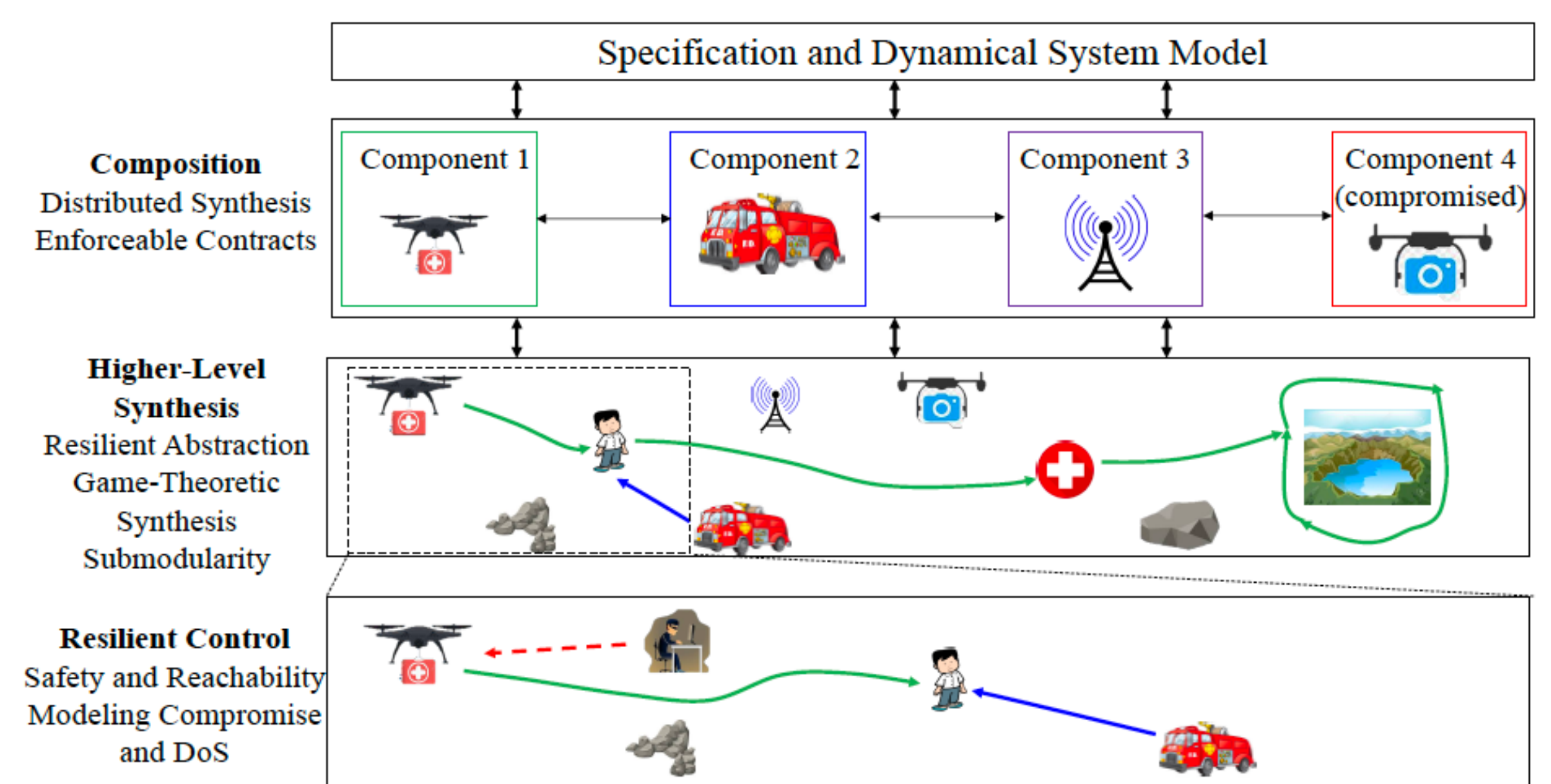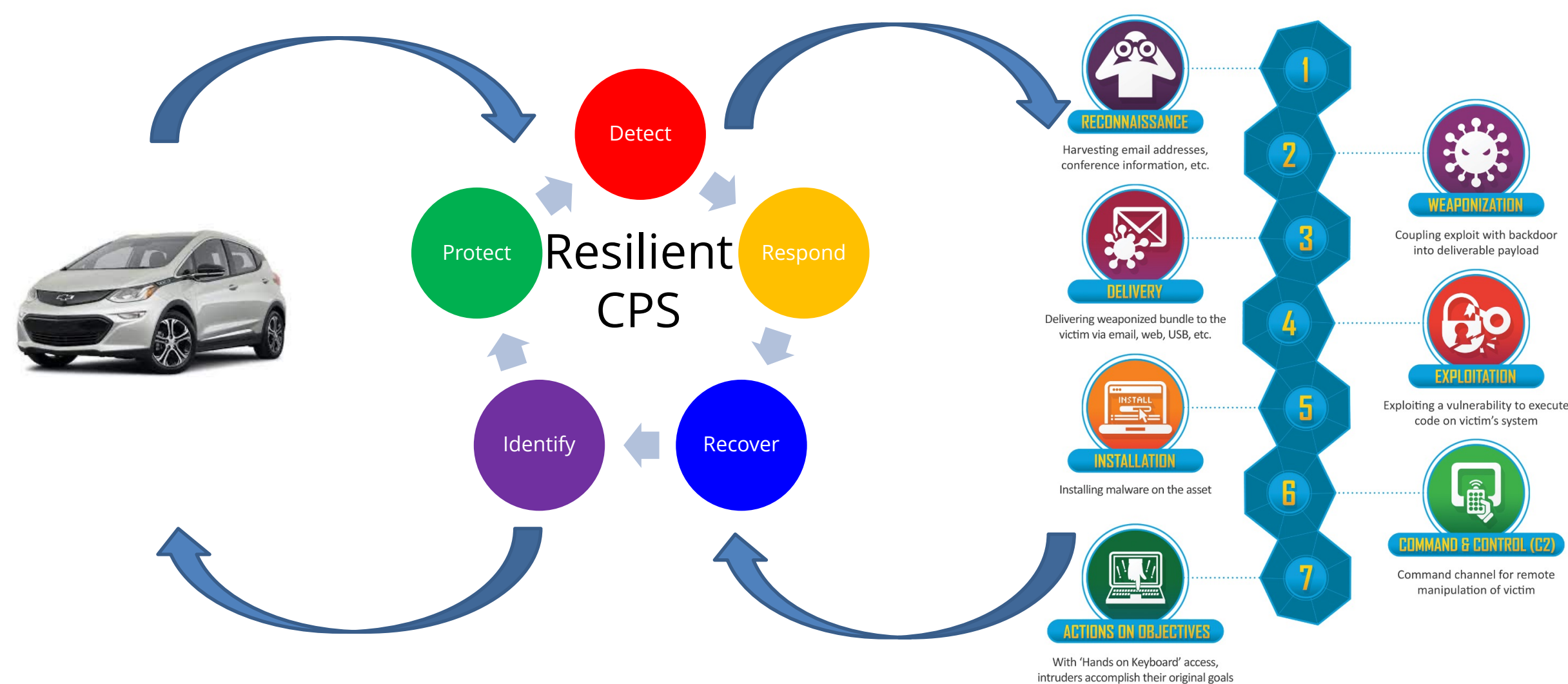# CAREER: Synthesis and Control of Cyber-Resilient CPS

PI: Andrew Clark, Dept. of Electrical and Systems Engineering, Washington University in St. Louis. Email: andrewclark@wustl.edu
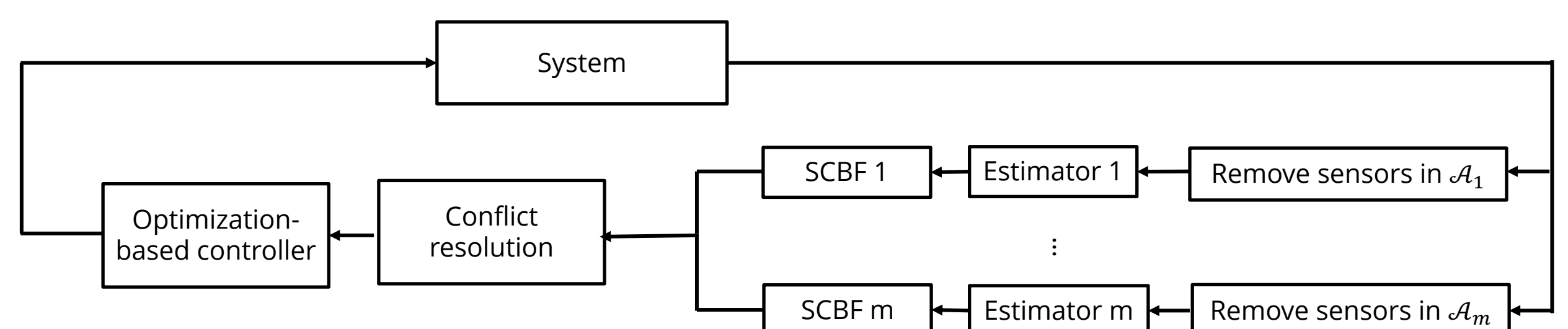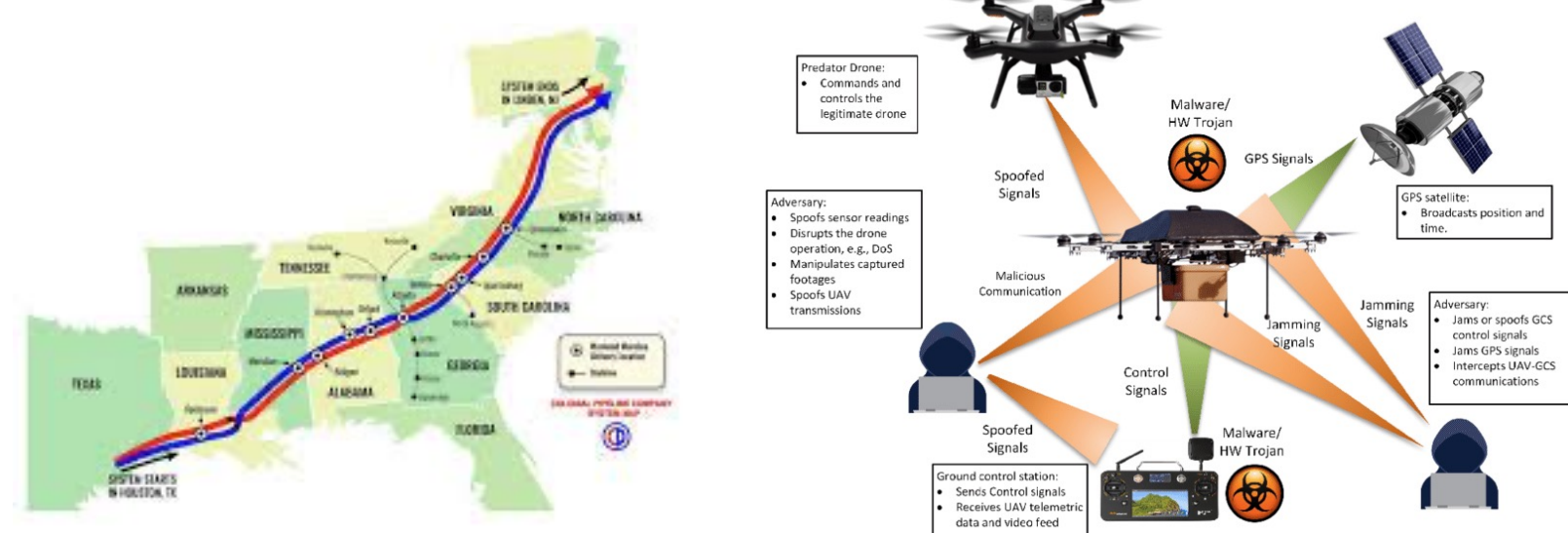
## Challenges

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

## Solutions

- Resilient Control Barrier and Lyapunov Functions for safety and stability
- Algebraic-geometric framework for safety verification

## Impact on application domains:

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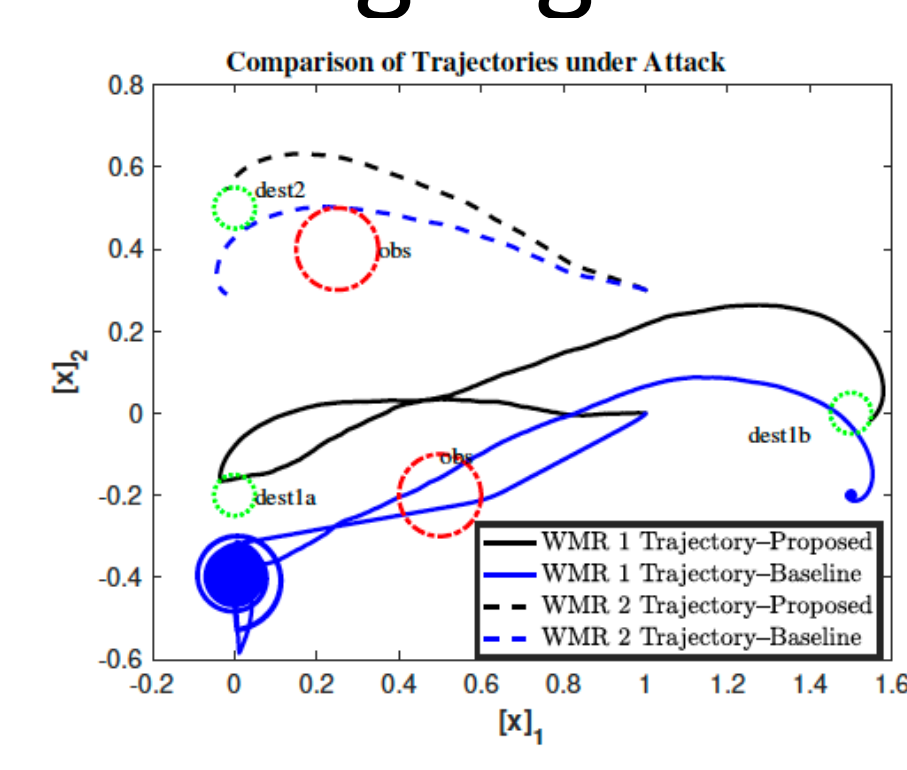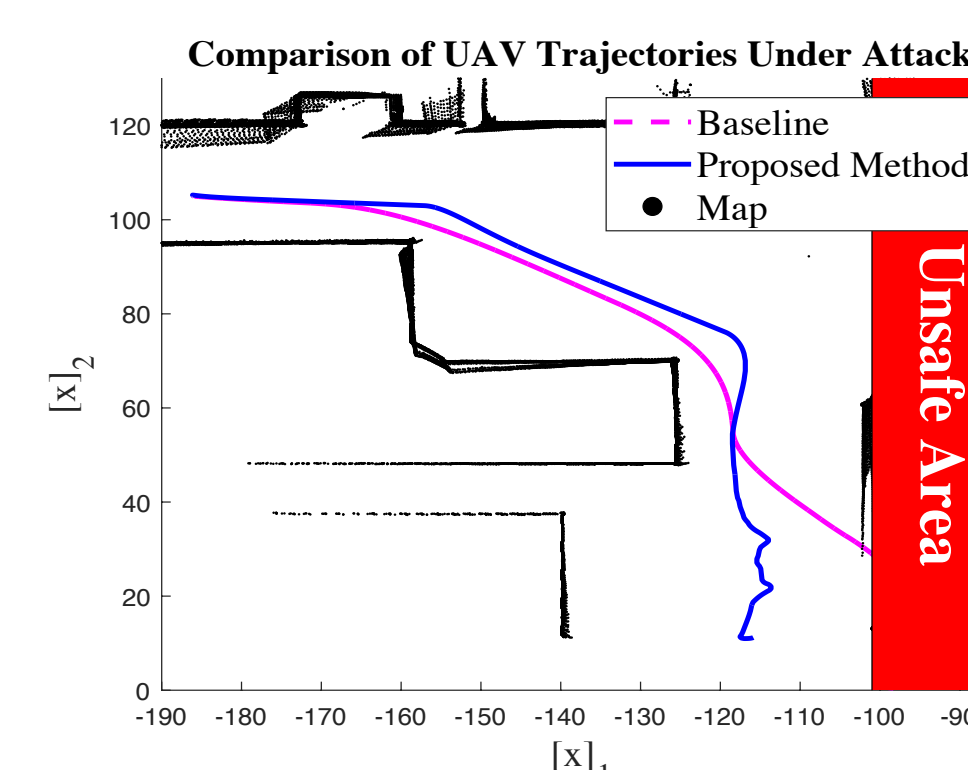
## Scientific Impact

- Algorithms for safety and performance under malicious attacks
- Scalable verification of safety and resilience
- Modeling impact of cyber attacks on complex specifications (liveness, task
- Discretization-free synthesis to satisfy task specifications
- Safe and resilient learning algorithms

## Education and Outreach:

- Undergraduate capstone projects
- Public outreach at WPI TouchTomorrow

## References:

[1] Z. Li, L. Niu, and A. Clark, "LQG Reference Tracking with Safety and Reachability Guarantees under Unknown False Data Injection Attacks." To appear in IEEE Transactions on Automatic Control (TAC), February 2023.

[2] A. Clark, "Control Barrier Functions for Stochastic Systems." Automatica, vol. 130, 2022.

[3] A. Al Maruf, L. Niu, A. Clark, S. Mertoguno, and R. Poovendran, "A Compositional Approach to Safety-Critical Resilient Control for Systems with Coupled Dynamics." IEEE Conference on Decision and Control (CDC), 2022.

[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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[6] L. Niu, D. Sahabandu, A. Clark, and R. Poovendran, "Verifiable Safety for Resilient Cyber-Physical Systems via Reactive Software Restart." IEEE/ACM International Conference on Cyber-Physical Systems (ICCPS), 2022.

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