Research Task / Overview

- Advance resilience contract methodology for closed-loop mission assurance.

![Diagram](image1)

Goals & Objectives

- Develop a probabilistic formal system model that enables incremental update of mission assurance assessment based on incoming sensor data.
- Exploit combination of deterministic and probabilistic modeling, and reinforcement learning to strike an effective balance between flexibility and verifiability.

Data & Analysis

- Exemplar Problem:
  - A simple system comprising prime (P) and redundant (R) computers cross-strapped to sensor & actuator interfaces:

![Diagram](image2)

- An initial Markov Model for a repairable system derived from invariant contracts might look like this:

![Diagram](image3)

- There can be many possible states between failed and working for computers, sensors and actuators, but we might not know what these are – for simplicity, we add a single hidden state, H1 and continue analysis:

![Diagram](image4)

Methodology

- Model system using a combination of:
  - Traditional contracts
  - Flexible contracts
  - POMDP

- Control flow model
- Swarm control architecture
- Iterative Bayesian belief update

Future Research

- Explore use of heuristics to dynamically modify POMDP policy
  - strictly formal/formulaic methods are insufficient to cope with real world complexity

- Pursue staged implementation
  - MDP on simple problem, POMDP on simple problem, in situ MA assessment on complex problem

Contacts/References