Robust Methods for Autonomous Fault-Adaptive Control of Complex Systems

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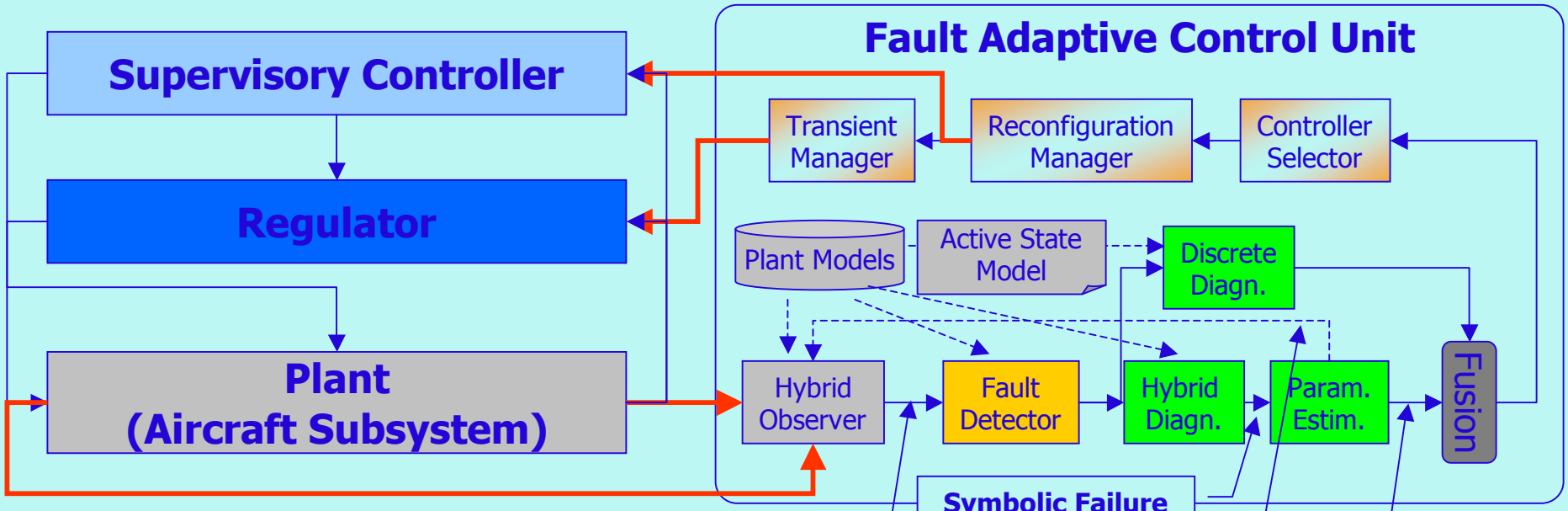
Work in Progress

- Continuing to build hierarchical hybrid model of the Water Recovery system in consultation with NASA engineers at NASA Johnson
  - Conceptual Issues being addressed: Compositional modeling of tightly versus loosely coupled subsystems
- Studying and analyzing data received from WRS testbed to estimate parameters of system
  - Looking at data for extended periods of time (four weeks) to understand anomalies and build fault detector for small changes
- Characterizing incipient faults in the water recovery system, and fault detection methods for incipient faults

Highlights of Recent Work

- Complete system for fault detection and isolation
  - Key issues:
    - Tuning of parameters for fault detection and symbol generation
    - Novel parameter estimation scheme for fault identification
    - Experimental studies of performance on fuel transfer system of fighter aircraft
    - Controller reconfiguration strategies

Technical Approach in Detail

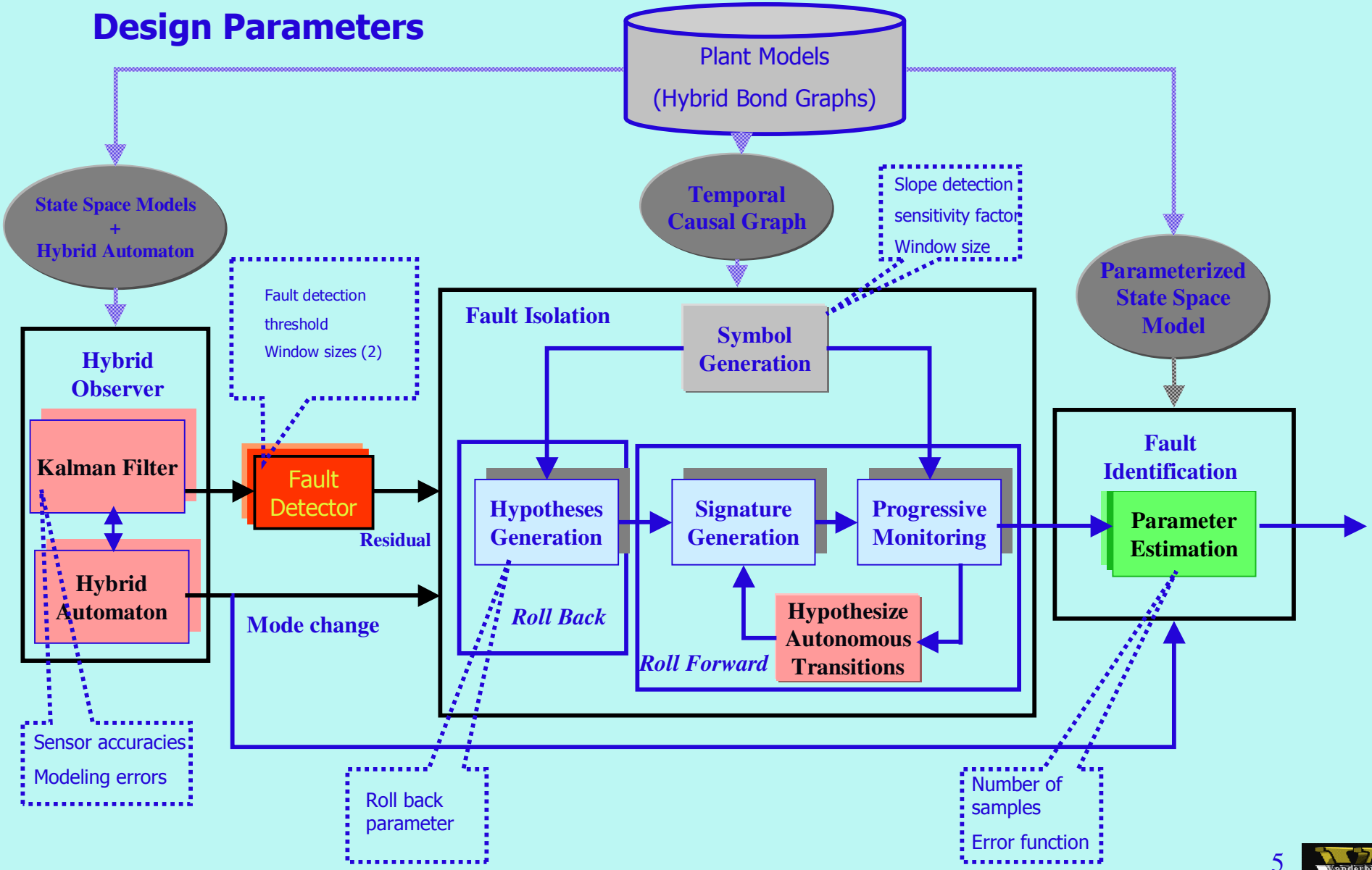


Metrics:

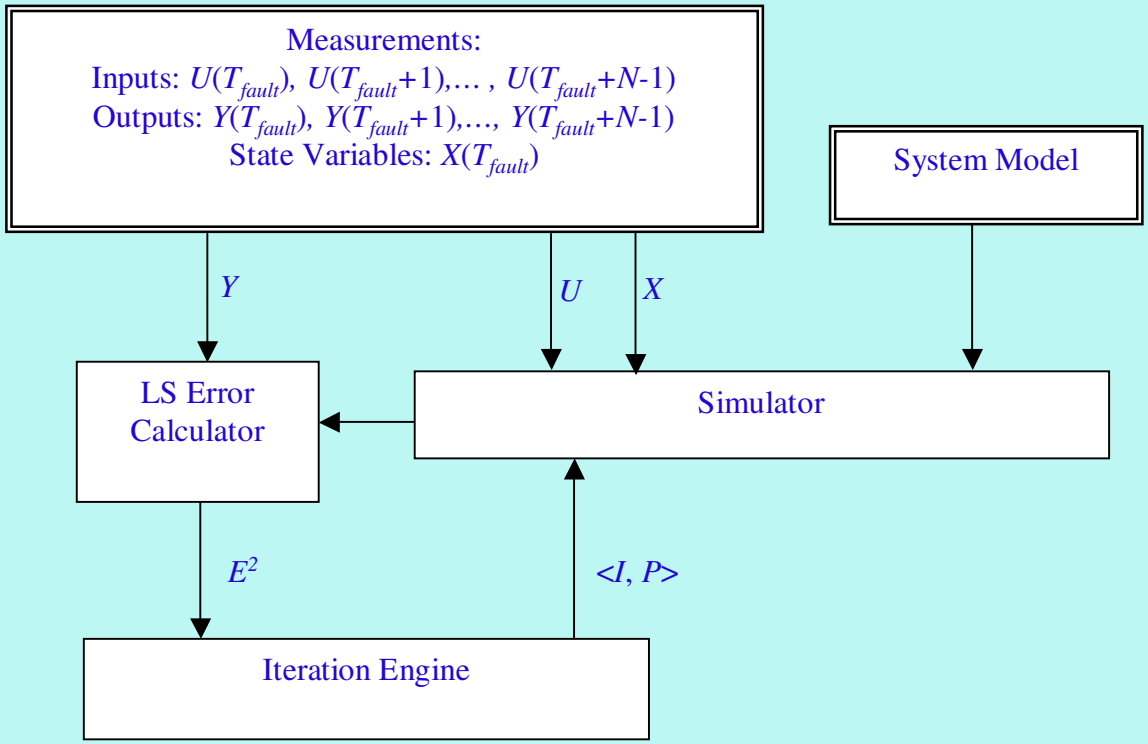
- *Fault detection/isolation:*
  - *Size of ambiguity group*
  - *Accuracy of fault magnitude estimate*
  - *Speed of D & I (system dependent)*
- *Reconfiguration:*
  - *Speed of R (system dependent)*
  - *Automatic choice of action*
  - *Transients are minimal*
- *Overall system functionality*
  - *Control objectives are achieved under degraded/faulty conditions*

Implementation: FDI system

Design Parameters



Parameter Estimation Technique



Goal:

Prune "symbolic" candidates, that do not explain observed dynamics.

Assumption:

The parameter estimation procedure will converge for the correct failure mode (and gives the correct fault magnitude value).