

Can Resilience Assessments Inform Early Design Human Factors Decision-making?

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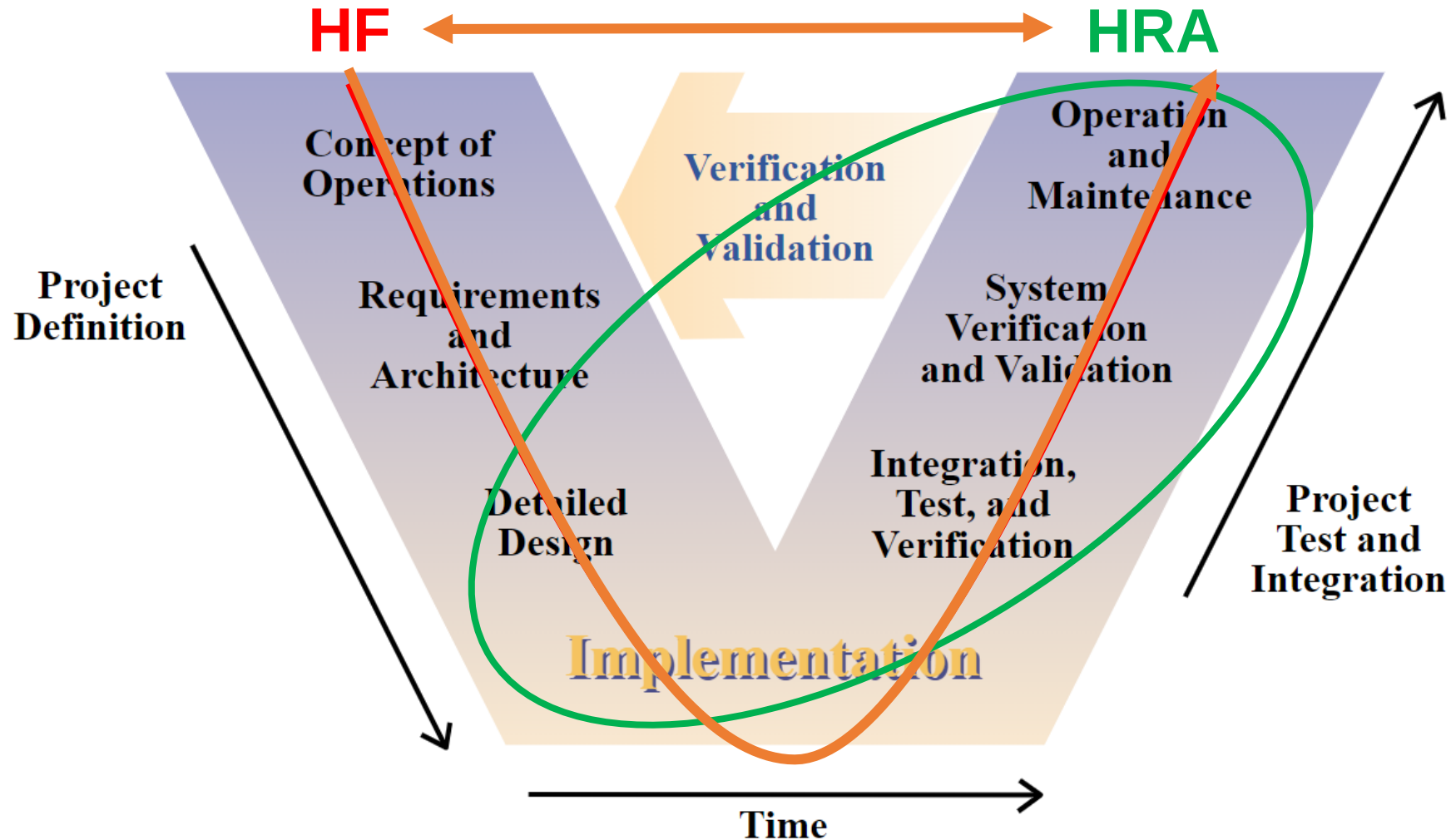
IFAC HMS 2022

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15th IFAC/IFIP/IFORS/IEA Symposium on Analysis
Design and Evaluation of Human-Machine Systems
Cognitive Systems Engineering and Resilience



Motivation

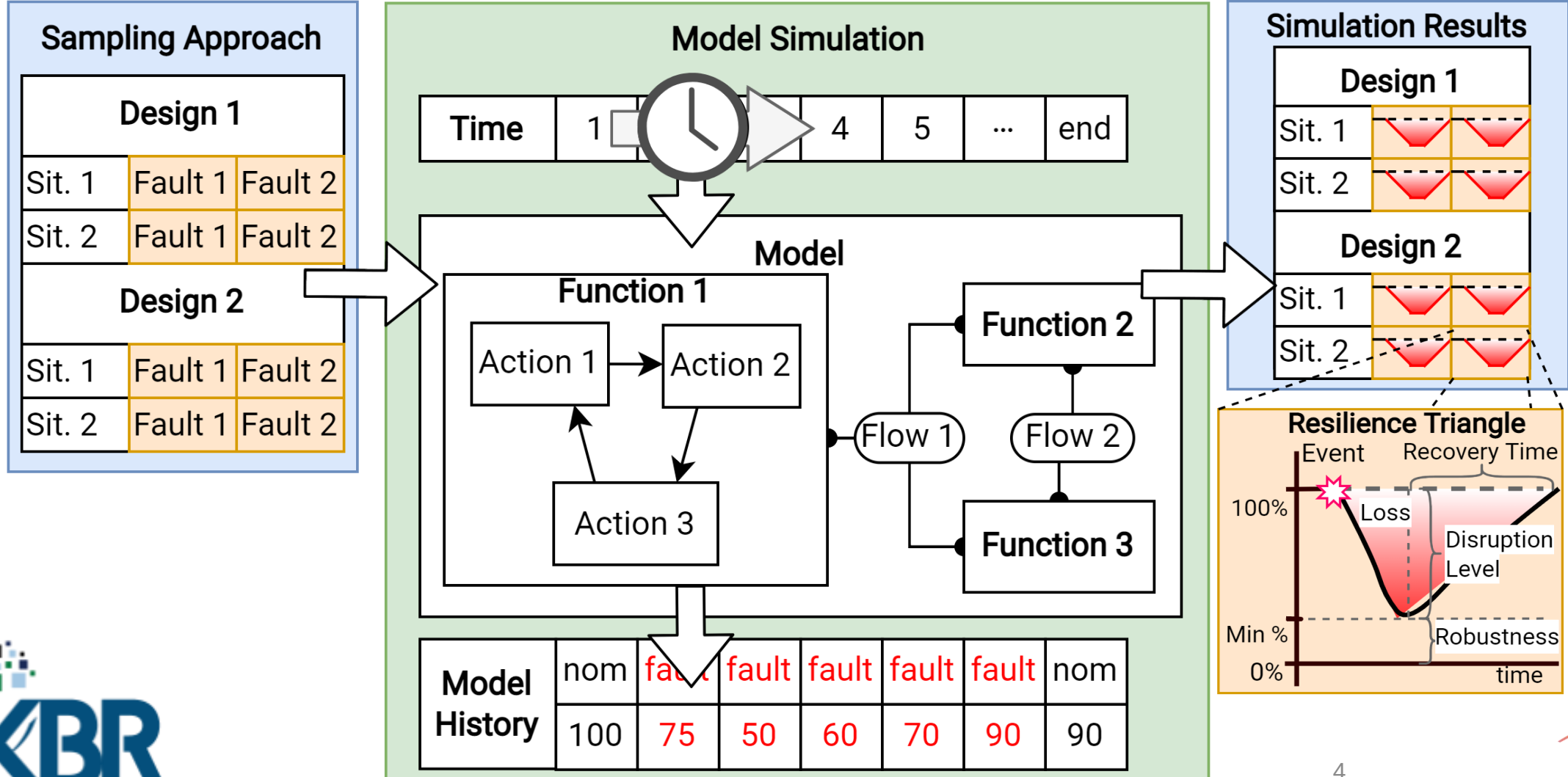


Motivation

- Resiliency – “failures and unexpected events will happen, and when they occur, complex engineered systems should be able to operate within acceptable bounds and recover reasonably”
- Human and resilience
- Existing methods focus more on the organization
- fmdtools

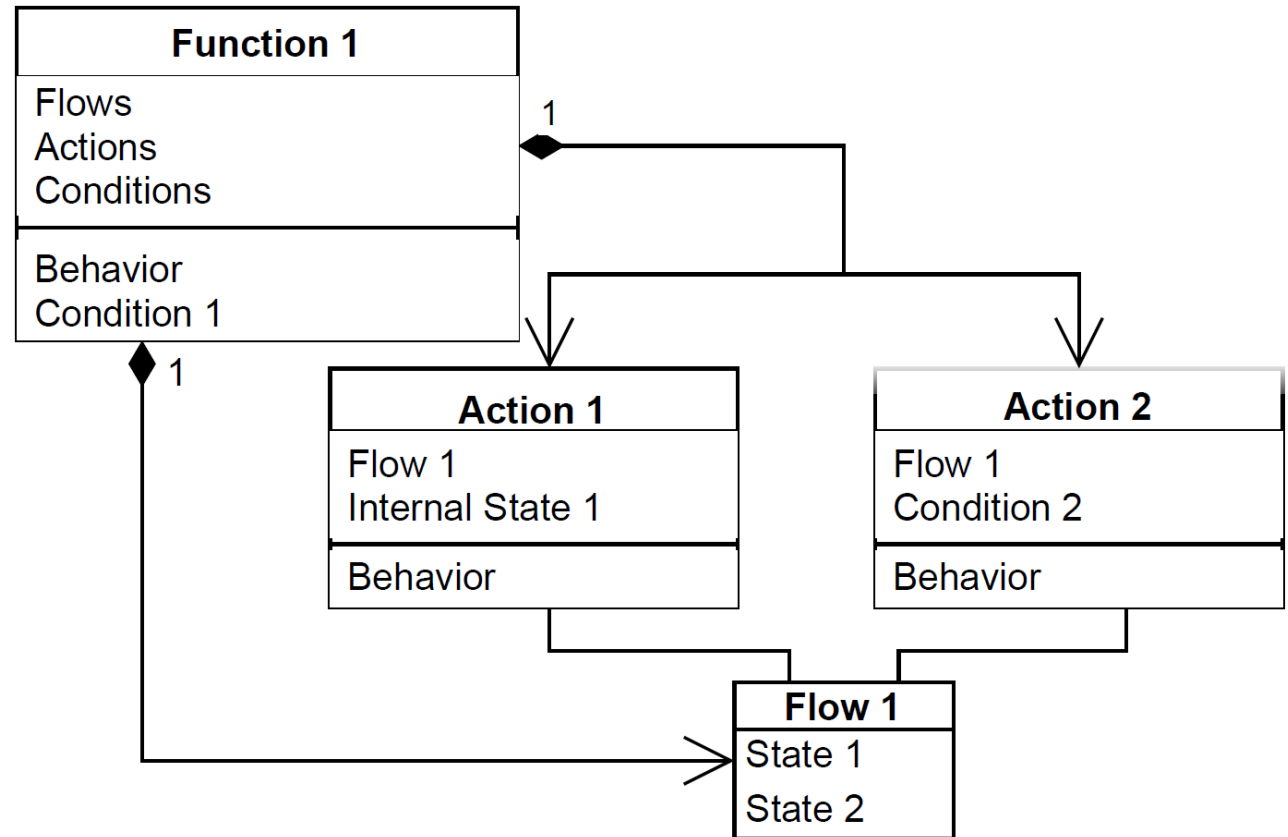


The fmdtools Toolkit



Performance Shaping Factors

- Global performance shaping factors
- Local performance shaping factors

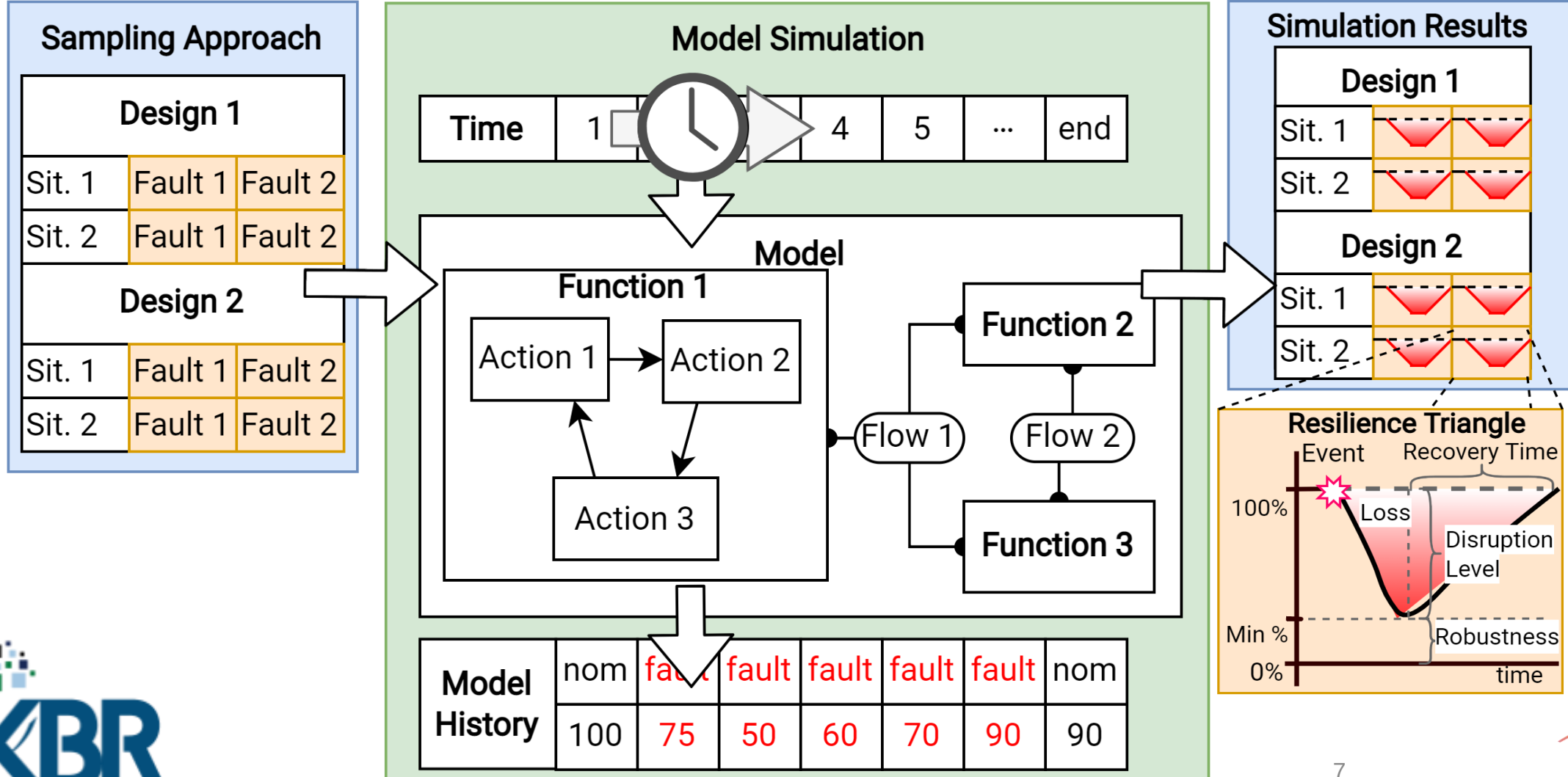


Action Sequence Graphs

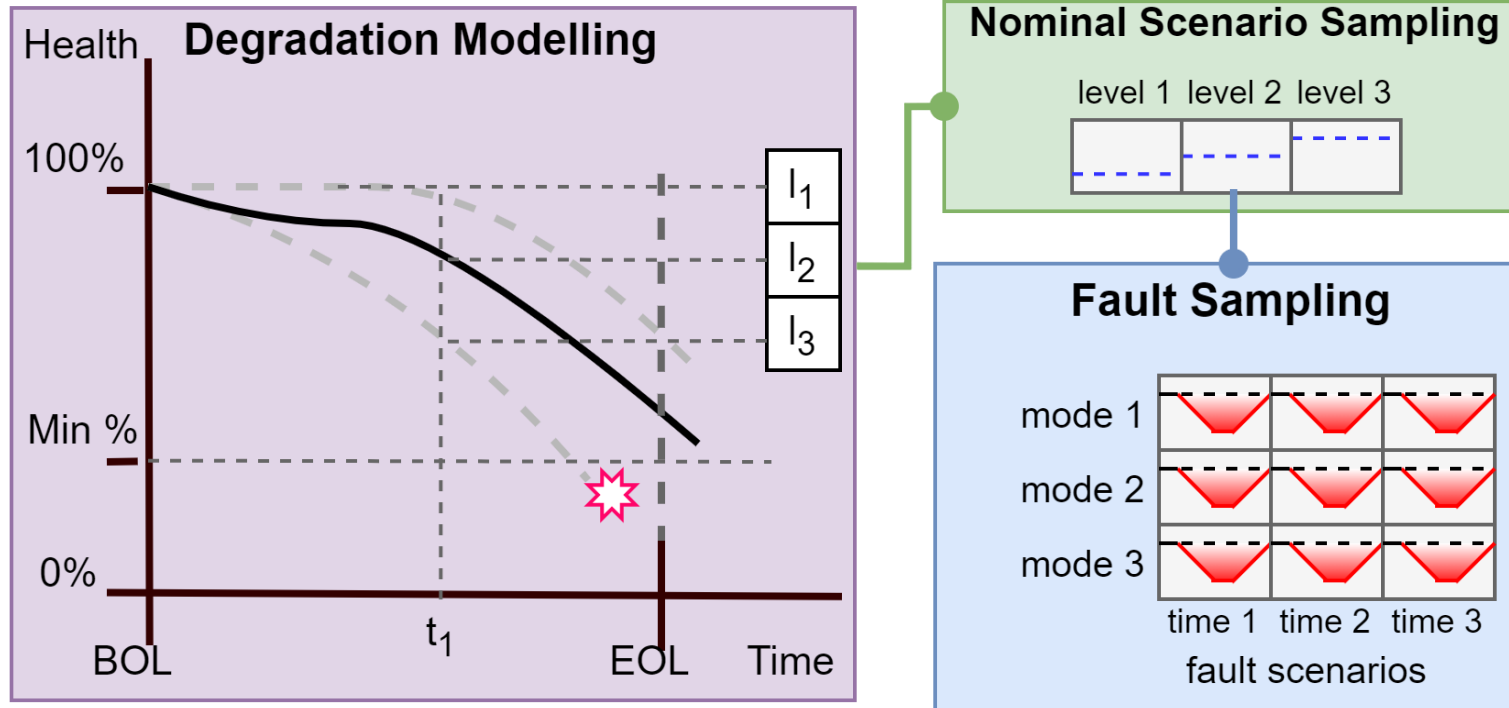
- Cognitive Processing models
- Multiple Operators
- Team Dynamics
- Systems of Systems



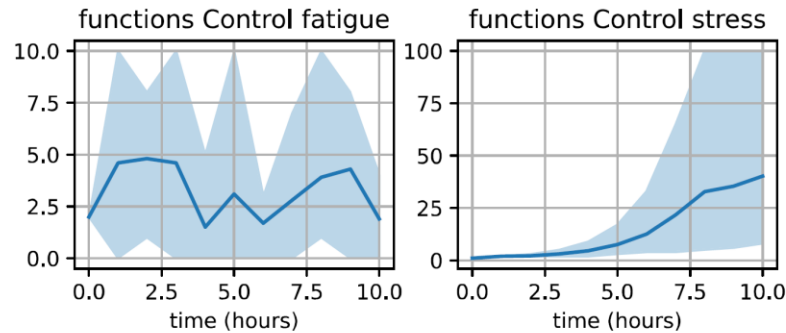
Degradation Modeling



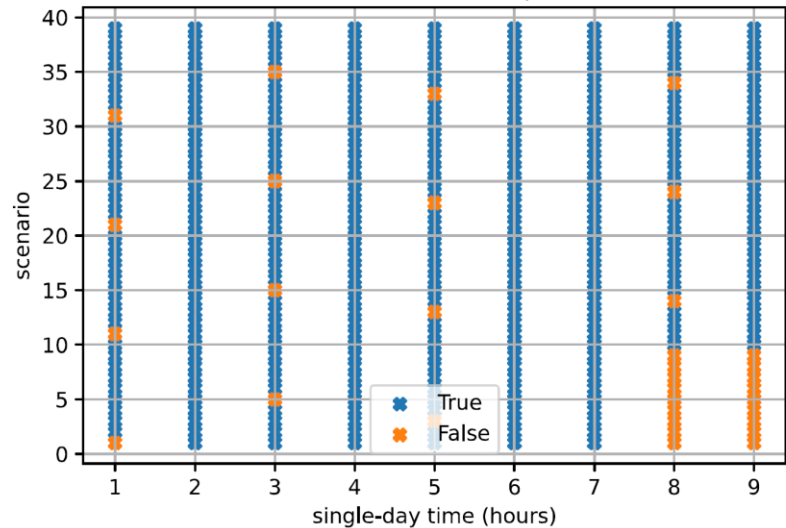
Degradation Modeling



Discussion – Degradation Modeling



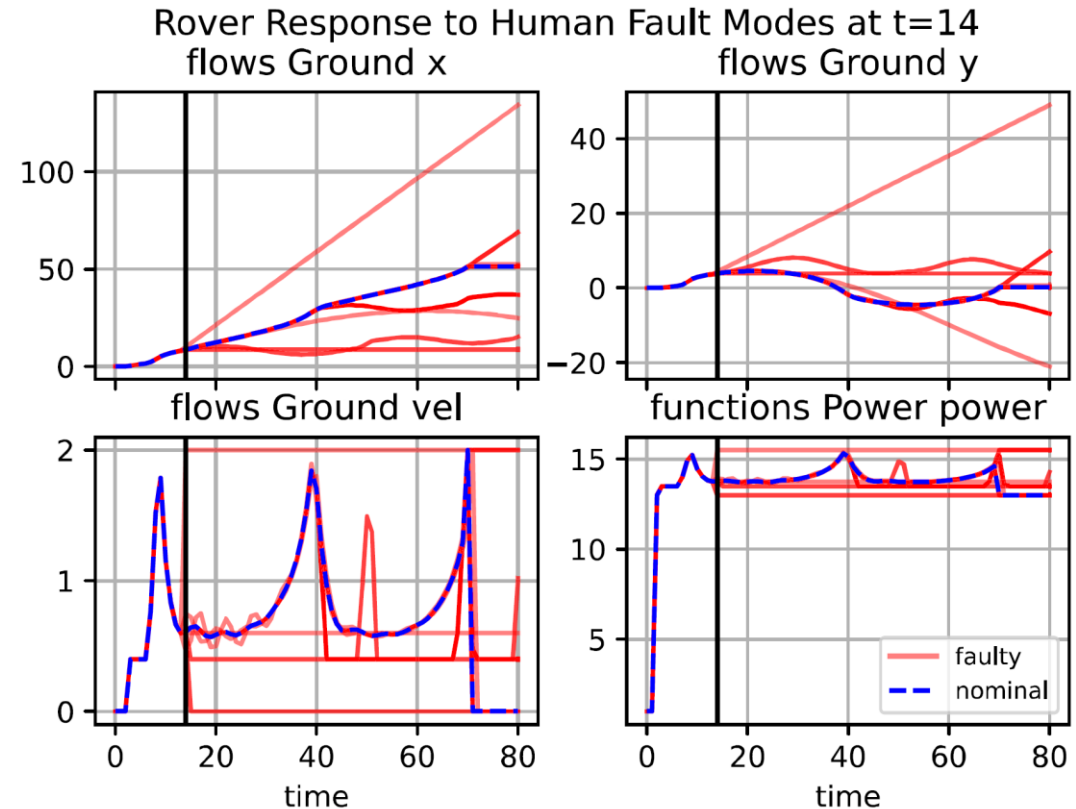
(a) Short-term PSF (stress and fatigue) degradation
Nominal Mission Completed?



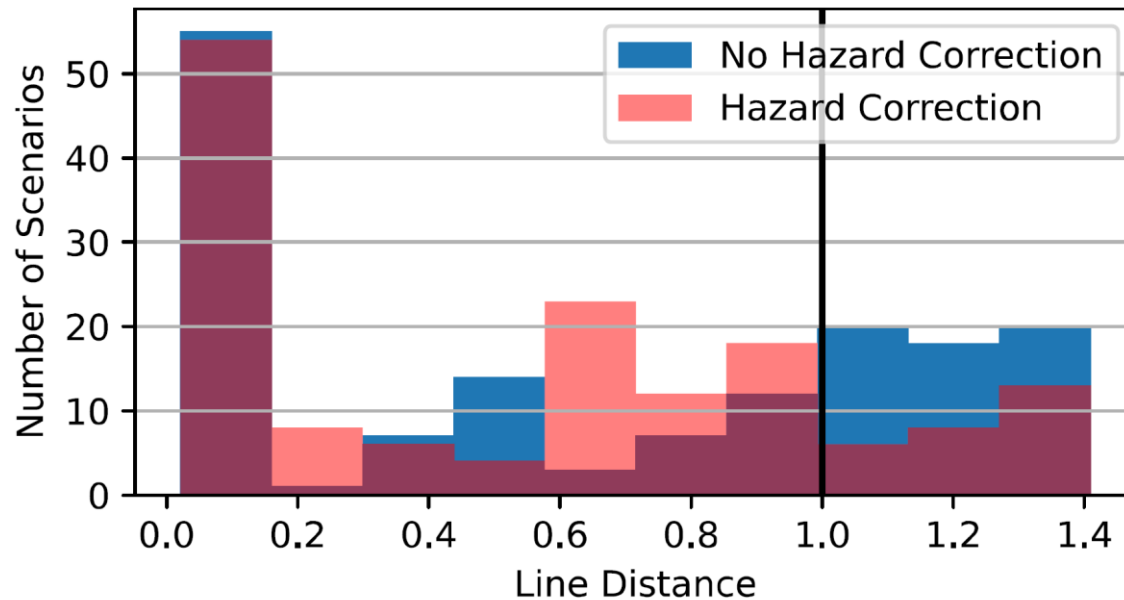
- Long term PSF effects
- System factors: shift length, training intensity, etc.
- Breaks and shift lengths
- Low experience = shorter shift

Discussion – Safety I

- Worst-case fault modes
- Design features, operating procedures, training



Discussion – Safety II



- Failures from elsewhere
- Warnings and feedback
- Identify risk + study mitigations

Considerations and Future Avenues

- Human errors Vs. human's adaptive capacity
- Fidelity
- To **complement, not replace**
- Complex applications
- Situation awareness modeling



Takeaways

- Human-machine interaction-related failures modeling (including continuous-time dynamic simulations)
- Effects of performance shaping factors
- Human-system and team-system interactions modeling in systems of systems (using object-oriented simulation)

Questions?

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Fmdtools Simulation Package

repo:

github.com/nasa/fmdtools

documentation:

nasa.github.io/fmdtools/



Action Simulation

