

Integrated Modeling and Optimization of Engineering Decisions for Enhancing Civil Infrastructure Systems Resilience

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Introduction

Problem: Natural hazards threaten civil infrastructure systems, which can disrupt critical lifeline services when civil infrastructure is not resilient.

Goal: Create an integrated systems model with a systematic search among possible civil infrastructure engineering improvement decisions to determine the best and most cost-effective choices to improve system resilience.

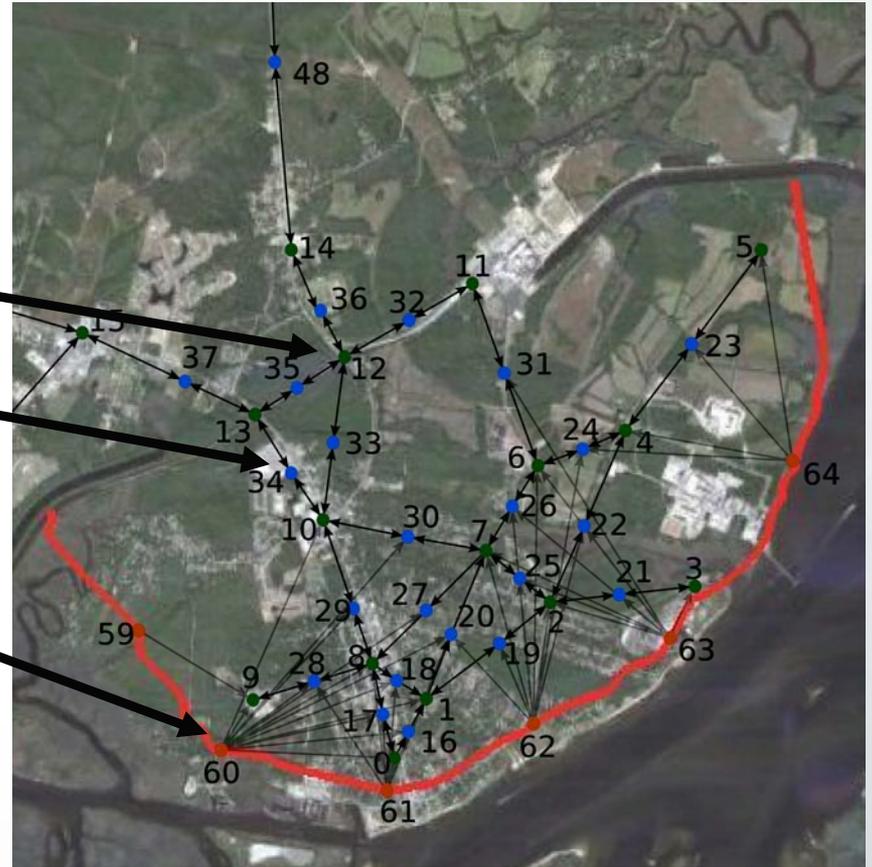
Civil Infrastructure Representation

- Nodes = components
- Arcs = relationships
 - Intersections
 - Roads

Physical Network

- Arcs represent physical and logical

Interdependency Network



System Performance Metrics

Goal: Increase system resilience to hazards

How can resilience be quantified?

What is a non-resilient

Assess the lifeline services provided by components

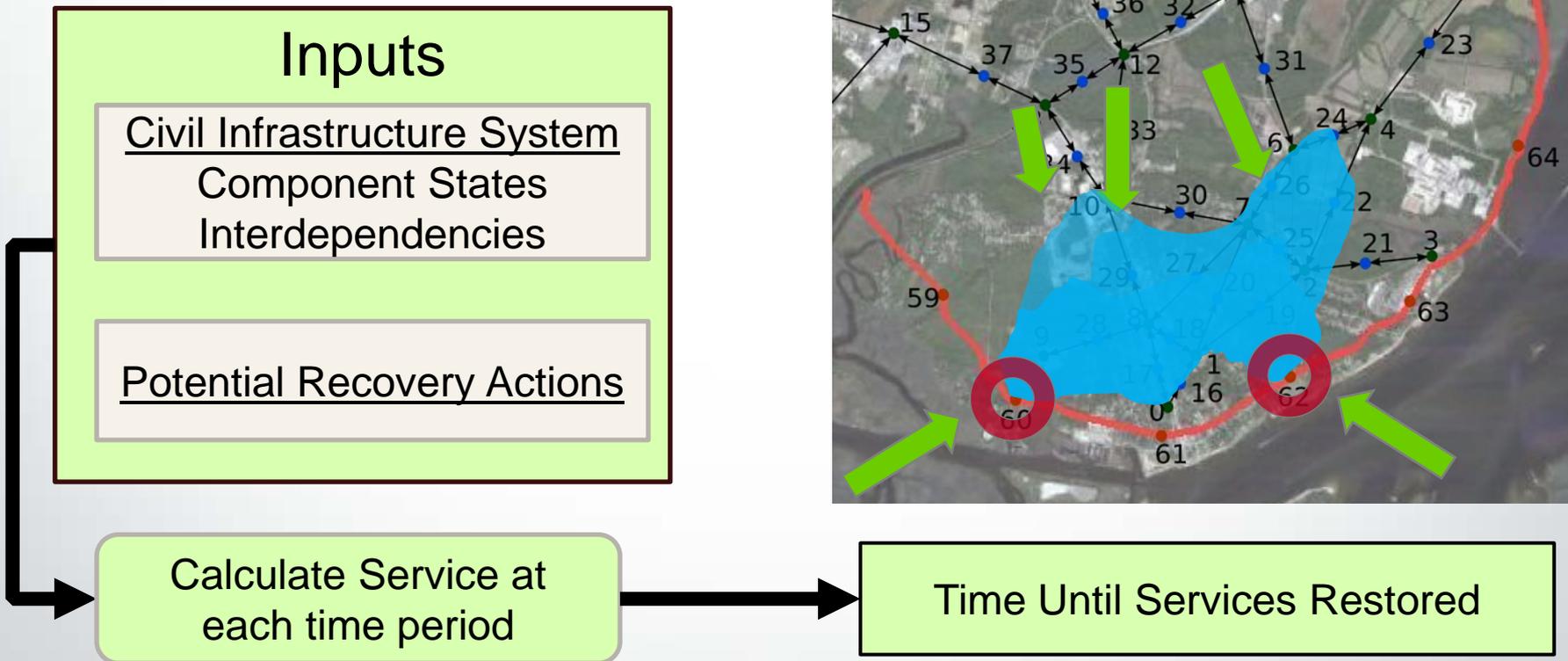
infrastructure system?

Design so that components can fail, but the system still provides services



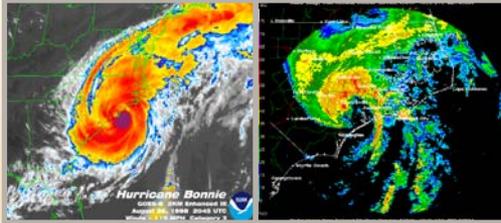
Metrics Example – Recovery Time

System resilience measured as the time until services restored

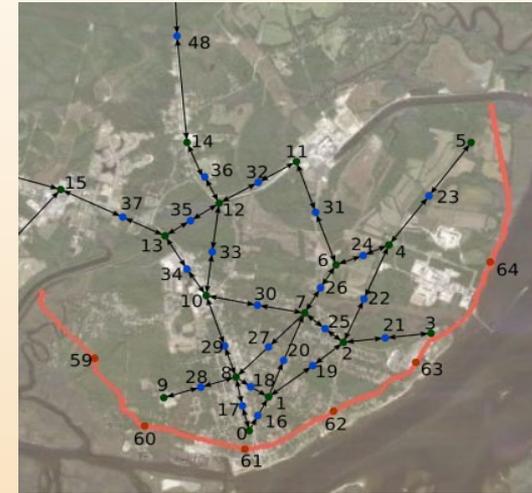


Scenario Analysis

Multiple Hazard Scenarios



Multiple Failure Scenarios

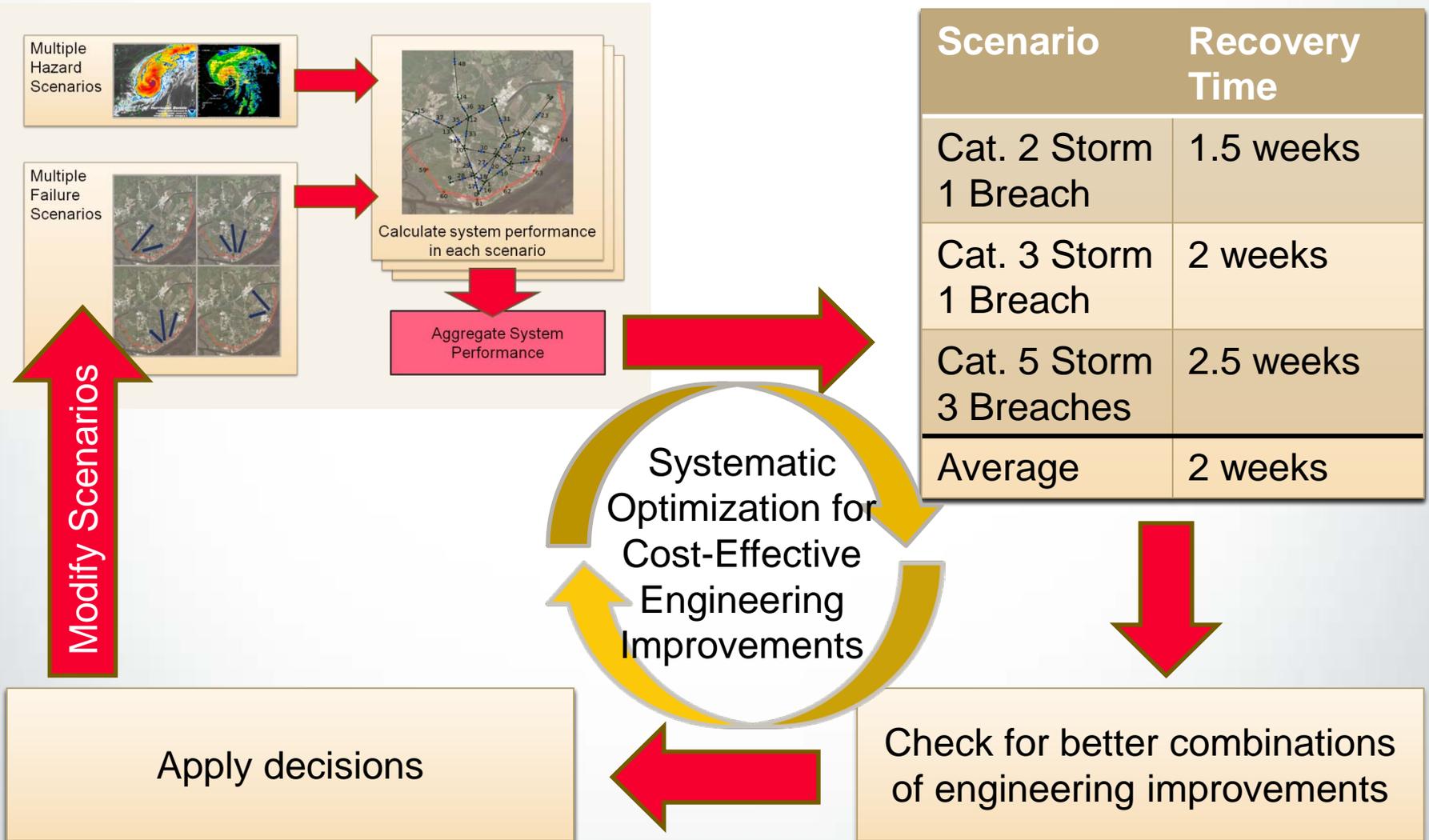


Calculate system performance in each scenario



Aggregate System Performance

Optimization Model



Current and Future Work

Sequences of Improvements and Scenarios

