SimCenter Community Roundtable
"Hurricane Regional Simulation at the SimCenter: New Directions and Community Preferences"
March 20, 2025

This SimCenter Community Roundtable meeting was organized by the **Working Group on Regional Simulation of Hurricanes**. This session highlighted the SimCenter's newly developed regional hurricane simulation capabilities, offering the user community an early look at upcoming releases and a chance to give feedback on the features and functionalities to be included as these workflows continue to evolve.

Host: Tracy Kijewski-Correa, University of Notre Dame

Presentations and Key Ideas

1. **"Regional Hurricane Risk Simulation: Current Capabilities and Development Roadmap"**
   Presenter: Adam Zsarnóczay, Stanford University & SimCenter
   This presentation showcased how SimCenter's WE-UQ, PBE, and R2D tools effectively bridge the gap between high-fidelity, local-scale analysis, and regional-scale risk assessment in the context of hurricane risk simulation. The presentation highlighted the integrated capabilities of these tools, leveraging a multi-hazard and multi-fidelity framework to simulate complex hazard events, estimate structural damage and losses, and model community recovery, as well as the testbeds that demonstrate these capabilities.

2. **"Accelerating the Integration of High-Resolution Methods for Hurricane Risk Assessment with a Unifying Framework"**
   Presenter: Rachel Hamburger, University of Notre Dame
   This presentation provided an overview of high-resolution regional hurricane risk assessment methodologies enabled by SimCenter's PBE tool and the Pelicun package, and the unifying framework that underpins these capabilities. The presentation discussed the potential uses of this framework to support granular, subassembly- and component-level assessments of hurricane impacts via coupling with WE-UQ's computational fluid dynamics (CFD). In addition, it provided a discussion of the applicability of these methods to damage and loss estimation for wind-induced pressures, wind-driven rain, and windborne debris demands, as well as a call for community contribution over time.

3. **"Regional Hurricane Risk Simulation: Creating Inventories of the Built Environment"**
   Presenter: Barbaros Cetiner, UC Berkeley & SimCenter
   This presentation illustrated the current and upcoming features of SimCenter's BRAILS++ package for generating inventories of the built environment. It summarized BRAILS' four-pronged approach to inventory generation involving scraping public datasets, extracting data from publicly available images, inferring missing information through statistical imputation, and applying rule-based logic. The presentation also demonstrated how BRAILS can seamlessly interface with the R2D tool to support regional-level risk assessments.

Discussion Highlights

- There is a notable lack of datasets providing time series of wind and storm surge data. Moreover, current risk assessment methodologies are not well-equipped to incorporate such temporal hazard information. This gap poses challenges for accurately simulating correlated systems, such as network infrastructures, within the dynamic context of hurricane events.
- Existing literature on component-level vulnerabilities of buildings to wind hazards primarily focuses on single-family homes. There is a pressing need for similar studies targeting commercial buildings, high-rise structures, and manufactured homes.
- There is a need to account for and quantify the correlation between component- and subassembly-level fragility functions when estimating overall damage and losses to individual assets, such as buildings and bridges, through these functions.
- Additional data on transportation networks, e.g., speed limits and the number of lanes, which are typically not available on public databases, is needed for realistic simulations of evacuation patterns in transportation networks.
- There is a need for historical inventory data to support regional-level risk assessments, a gap that BRAILS++ can help address to some extent.

More Information

- Additional SimCenter Community Roundtable meetings can be found at https://simcenter.designsafe-ci.org/collaborate/scr/.
- SimCenter's component-level building fragility function database for wind hazards is available at https://github.com/NHERI-SimCenter/DamageAndLossModelLibrary/tree/main/hurricane/building/component.
- To explore SimCenter's regional-scale inventory creation tool, BRAILS++, please visit https://github.com/NHERI-SimCenter/BrailsPlusPlus.