Detecting Building Vulnerabilities to Natural Hazards at Large Scale Using Deep Learning

NHERI Center for Computational Modeling and Simulation

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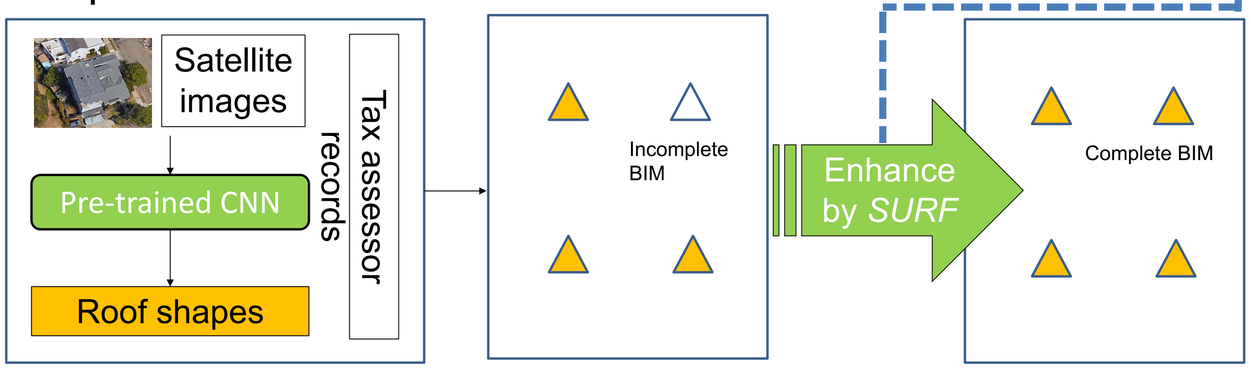
Framework (BRAILS)

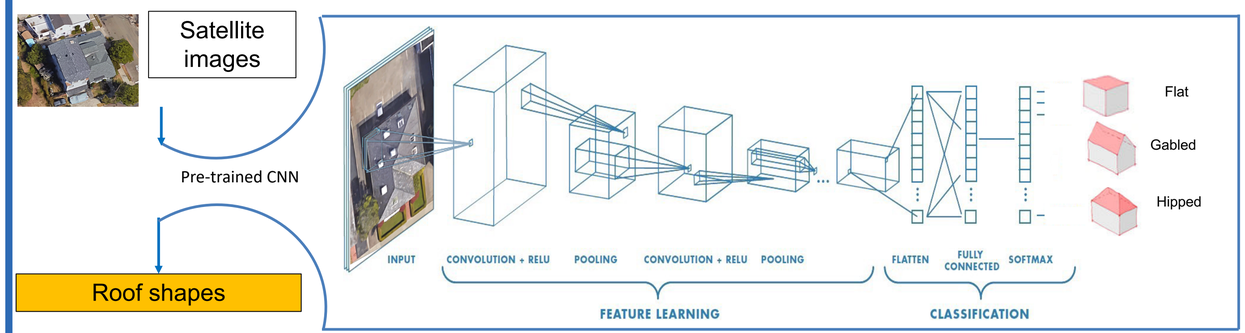
Codes and released BIM database can be found on GitHub: https://github.com/NHERI-SimCenter/BRAILS

1. Hurricane Testbed

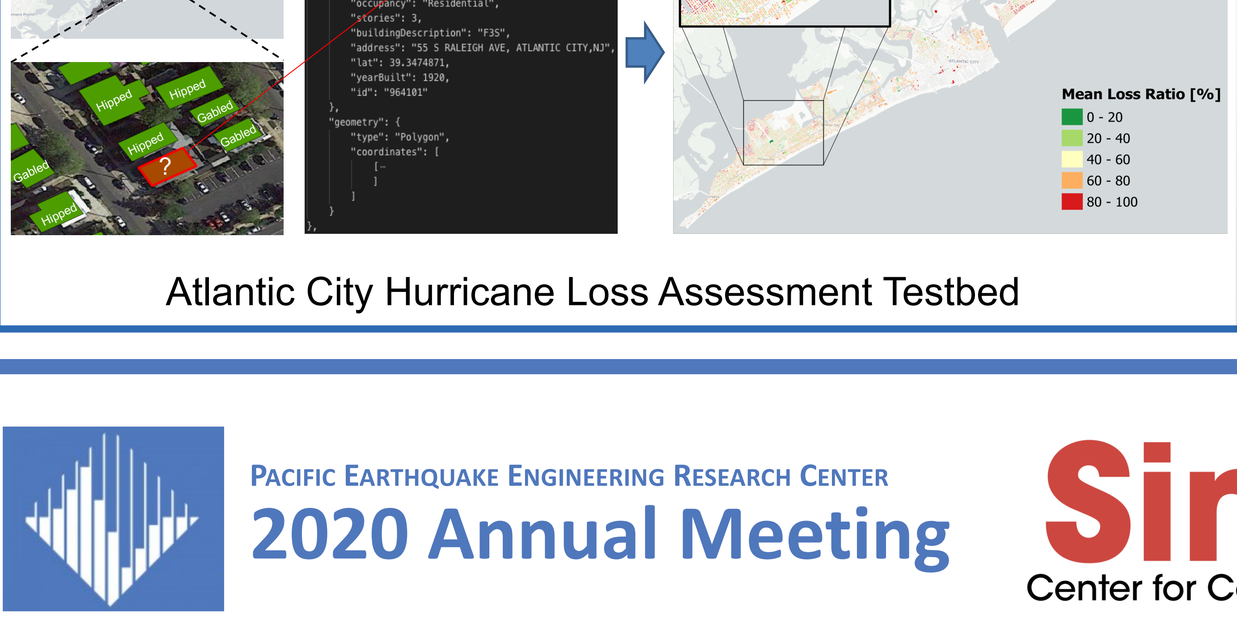
We used BRAILS to create a building inventory database for several coastal cities in New Jersey. Based on this database, we performed a loss assessment under a hurricane scenario.



We collected tax assessment records, which are scraped from administrative websites. Building information found in the records include number of stories, year of construction, structure type, occupancy. The second data source is satellite images, which can be download by calling Google Maps API.



A pretrained ConvNet is used to classify roof types based on satellite images.

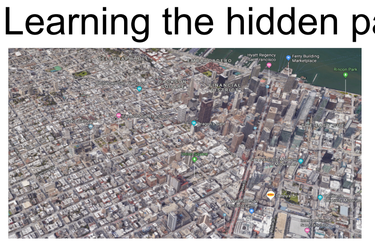


Atlantic City Hurricane Loss Assessment Testbed

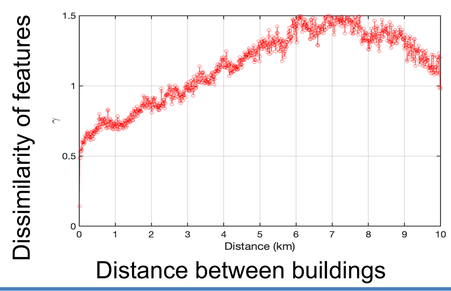
SURF: Spatial Uncertainty Quantification & Data enhancement

https://github.com/NHERI-SimCenter/surf

Learning the hidden patterns of the built environment.



There are patterns in the built environment.



$$\int feature * prob = expected\ feature$$

Spatial Uncertainty Quantification

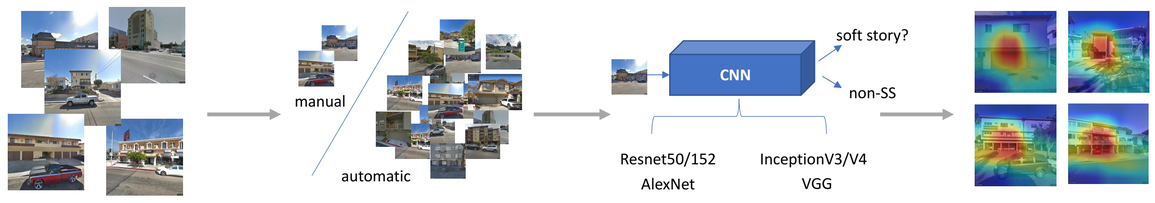
Random fields | ***Neural nets***

2. Earthquake Testbed

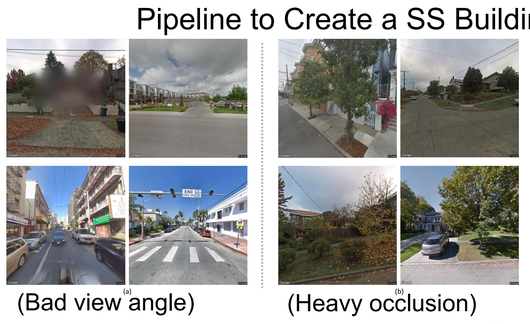
We used BRAILS for city-scale detection of soft-story (SS) buildings.

A SS building is the one that has a story whose stiffness is dramatically less than other stories. SS buildings are prone to collapse during major earthquakes.

Typical SS buildings

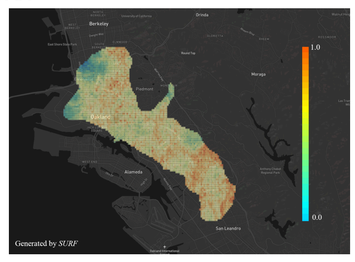


Pipeline to Create a SS Building Classifier



(Bad view angle) (Heavy occlusion)

Noises in Data



Predicted Probability of SS Buildings

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