

Session ID: AIM-3

Title

SENSE AND SENSIBILITY OF MACHINE LEARNING IN NATURAL HAZARDS ENGINEERING

Convenors

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Description

Advances in parallel computing coupled with digitalization of infrastructure promise many advantages for design optimization, sustainable use of infrastructure, and risk mitigation. Yet, even if such digitalized assets were all readily available, they currently could not be tractably nor sustainably leveraged without substantially sacrificing prediction fidelity. For instance, consider a M7.8 scenario earthquake affecting L.A. City, USA. If each of the ~1,480,000 structures in the building stock were crudely modeled solely using 2D concentrated plasticity frames up to four stories high, it would take about 17 years of CPU time to perform response history analyses for this scenario. This is achievable in ~12 hours using a cluster with ~12k CPUs. However, quantifying the updated risk would require on the order of thousand such analyses, or about 1.5 years of parallel computation time on the same cluster. The problem gets even more challenging if one is to consider direct simulations of underlying ground motions or life-cycle optimization.

With the above discussion in mind, this technical session focuses on the intersection of high-fidelity simulations and data-driven approaches in earthquake engineering. We invite studies that leverage synergies between nonlinear analyses and surrogate modelling to advance our capabilities of hazard and risk quantification, and design optimization. The common threads for the session are data quality, interpretability, and limitations/opportunities afforded by coupling the data-driven and physics-based approaches. As such, the envisioned learning objectives for the session are: (1) to understand how data-driven approaches can complement physics-based simulations, (2) how machine learning techniques enhance design and hazard/risk assessment, (3) at what point do the simulations become intractable despite the advances made in parallel computing, and (4) which otherwise elusive questions can be tackled by a combination of these tools.

Invited Speakers

A. Hulseley ⁴, J. Padgett ⁵, B. Simpson ⁶, B. Sudret ⁷

Affiliations

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