# RELIABILITY ANALYSIS AND RARE EVENT SIMULATION

## TRACK NUMBER 2000

## MAX EHRE[*], DIMITRIS GIOVANIS[†], IASON PAPAIOANNOU[*], EDOARDO PATELLI[§], DANIEL STRAUB[*] AND BRUNO SUDRET[‡]

[*] Engineering Risk Analysis Group, Technichal University of Munich
Theresienstraße 90, 80290 Munich
max.ehre@tum.de, iason.papaioannou@tum.de, straub@tum.de

[†] Department of Civil and Systems Engineering, Johns Hopkins University
Baltimore, MD, 21218, USA
dgiovan1@jhu.edu

[§] Centre for Intelligent Infrastructure, Department of Civil and Environmental Engineering, University of Strathclyde
16 Richmond St, Glasgow G1 1XQ
edoardo.patelli@strath.ac.uk

[‡] Chair of Risk, Safety and Uncertainty Quantification, ETH Zürich
Stefano-Franscini-Platz 5, 8092 Zurich
sudret@ethz.ch

**Key words:** Reliability analysis, rare events, reliability-based optimization, reliability sensitivity analysis, Bayesian updating, surrogate modeling, digital twins.

## ABSTRACT

Reliability analysis is essential for the development, design and assessment of engineering systems under uncertainty. Challenges in computing the probability of failure are associated with non-linear system behaviour, large numbers of uncertain parameters and failure/rare events inducing multiple, disconnected failure domains. We invite talks discussing efficient computational methods for simulating rare events and quantifying failure probabilities based on sampling, surrogate modelling and machine learning as well as approximation approaches. Relevant applications of these techniques are in the assessment of static and dynamical engineering systems, reliability-based design optimization, reliability-oriented sensitivity analysis, Bayesian updating of failure probabilities with real-time data and applications in digital twin models.