

The NASA and DNV Challenge on Optimization Under Uncertainty

Announcement

December 3, 2024

Motivation

NASA missions often involve the development of new vehicles and systems that must be designed to operate in harsh domains with a wide array of operating conditions. Similarly, DNV works to safeguard life, property, and the environment across a range of industries by ensuring that complex engineered systems can be trusted to operate reliably, even during rare and extreme events. DNV collaborates across various sectors to address the challenges of designing and operating safety-critical systems. Both NASA and DNV deal with high-consequence and safety-critical systems for which quantitative data is either very sparse or prohibitively expensive to collect. Limited heritage data may exist, but is also usually sparse and may not be directly applicable to the system of interest, making UQ extremely challenging.

Recognizing the shared challenges in UQ across different sectors, NASA Langley Research Center and DNV Group Research and Development have developed a challenge problem to unite a community of researchers toward common goals. While the problem formulation is presented in a discipline-independent framework, the underlying application is consistent with the complexities of realistic systems. This collaborative effort aims to advance methodologies in UQ that are broadly applicable, enhancing safety and reliability across various domains.

This challenge aims to advance research within:

- Modeling and refinement of uncertainty given sparse data
- Propagation of mixed aleatory and epistemic uncertainties through system models
- Design optimization in the presence of uncertainty

Register for the 2025 UQ Challenge

Each participating group should first register by sending an email to uqchallenge@dnv.com including the name of all the participants, their email address and affiliations. Furthermore, let us know who will be the point of contact for the group.

Accepted responses to the challenge will be part of a dedicated session of the [ESREL 2025 conference](#) to be held in Stavanger, Norway, from 15-19 June 2025. Registration to the conference is done separately through the conference website.

The challenge problem

The problem to be solved is described in the pdf available [here](#).

Link to local simulation model: **Will be available January 6th.**

The simulation model will take as input a vector $\mathbf{X} = (\mathbf{X}_a, \mathbf{X}_e, \mathbf{X}_c, \omega)$, consisting of aleatory, epistemic, and control variables with dimensionalities $n_a = 2$, $n_e = 3$, and $n_c = 3$, respectively. Additionally, there is an aleatory variable ω representing the random seed.

Generation of data from the real system: Each participating team will get access to an online solution for generating (synthetic) data from the real system with the control parameter \mathbf{X}_c they specify. Guidance for how to access this will be given by email to the registered teams.

Timeline

December 27th: Deadline for registering new teams

January 6th: Start of challenge. Access to simulation models and data will be opened.

March 17th: First paper deadline. We aim to review and provide feedback to each team within 1 week - Monday 24th of March.

March 31st: Deadline for submitting numerical results. A template will be provided for submitting the numerical results.

April 10th: Deadline for camera ready paper.

See also <https://esrel2025.com/> for deadlines regarding conference registration.

Questions and Answers (updated as new questions arrive)

Answers to any question we receive that is relevant for all respondents will be posted [here](#).