LASAR 3
Laboratory of Analysis of Systems for the Assessment of Reliability, Risk and Resilience

MSc thesis proposal

- **Title of the research**

Deep Learning based Acceleration of Probabilistic Risk Assessment for the Siting of Nuclear Power Plants

- **Objectives of the research**

The siting of nuclear power plants requires the evaluation of population exposure to radioactive fallout following severe nuclear accidents. Probabilistic Risk Assessment (PRA) accounts for uncertainty in radionuclide atmospheric dispersion, surface deposition and exposure pathways to estimate the probability that the maximum radiation dose within the evacuation zone exceeds a specified regulatory threshold. Estimating this probability across multiple candidate sites requires performing numerous computationally expensive numerical simulations. This thesis proposes combining *deep learning metamodels* and *dimensionality reduction techniques* to accelerate the PRA analysis. The objective is to reduce the computational costs while maintaining accurate probability estimates to support risk-informed decisions on the siting of nuclear power plants.

References

- Coscia, T. M., Di Maio, F., Heo, G., & Zio, E. (2025). Probabilistic safety assessment of nuclear power plants considering climate change. *Reliability Engineering & System Safety*, 111590.
- Sinha, V., Atikler, M., & Mileski, M. (2024). Atmospheric dispersion of radioactive materials for radiological risk assessment in case of hypothetical sodium cooled fast reactor accident. *Nuclear Engineering and Design*, 422, 113124.
- Hvala, N., Mlakar, P., Grašič, B., Božnar, M. Z., Perne, M., & Kocijan, J. (2023). Surrogate tree ensemble model representing 2D population doses over complex terrain in the event of a radiological release into the air. *Progress in Nuclear Energy*, 158, 104594.

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