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# Editorial: Artificial intelligence in advanced nuclear reactor design

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term memory (LSTM)

## Editorial on the Research Topic

### Artificial intelligence in advanced nuclear reactor design

With the evolution of artificial intelligence (AI) technology, AI has become sophisticated and capable of solving complex problems in various fields, including manufacturing, finance, and education. In a similar vein, the rapid growth of AI has offered new considerations for the design of advanced nuclear reactors. Different to the traditional light water reactors, the advanced reactors have many innovative structures and accident conditions to consider. These reactors have necessitated cutting-edge technological approaches for their design and optimization. The integration of AI in this field is a testament to its transformative potential. It offers tools for the optimization of reactor design, autonomous control, and the development of advanced nuclear power software. To research the application of AI in advanced nuclear reactor design, the team of editors has curated a Research Topic in the journal *Frontiers in Nuclear Engineering* titled “Artificial Intelligence in Advanced Nuclear Reactor Design”. Five articles have been collected, and they cover different yet essential aspects of AI in advanced nuclear reactor design.

Lou *et al.* optimized the conceptual design of a lead-based modular nuclear power reactor core loaded with uranium alloy fuel, focusing on the selection of an optimal rod-to-diameter ratio and effective density to align with the core's power level and lifetime of the core.

Ejigu *et al.* have provided a comprehensive review of the interplay between AI technologies and big data, elucidating their integration with nuclear power plants and the ensuing opportunities and challenges for the nuclear industry.

Wei *et al.* have used computational fluid dynamics (CFD) to investigate the three-dimensional flow field under normal operating conditions in the reactor pressure vessel (RPV) in the Hualong One nuclear power plants (NPPs). With a particular focus on the flowrate distribution at the core inlet, the numerical framework is validated against the integral hydraulic experiment in a 1:4-scaled RPV of CNP1000, the prototype of the Hualong One reactor. The simulation results of the normalized flowrate at the core inlet agree reasonably well with the measured data. Based on the experimental data, several methods of calibrating the CFD turbulence model coefficients have been suggested by introducing the concepts of data assimilation and machine learning.

Li *et al.* have introduced a predictive method for loss of coolant accidents (LOCAs) in the HPR1000 reactor, integrating multi-headed self-attention mechanisms with quantile regression to enhance prediction accuracy and uncertainty assessment.

Lastly, Li and Chen et al. have applied a novel deep learning model, zLSTM, evolved from Long-short Term Memory (LSTM) networks, to predict LOCAs with enhanced long-term processing capabilities, thereby illustrating the profound impact of deep learning on nuclear safety analysis.

After 1 year of revisions and updates, this Research Topic “Artificial Intelligence in Advanced Nuclear Reactor Design” finally selected these five articles, which have now been published in the journal *Frontiers in Nuclear Engineering*. The Research Topic underscores the growing intersection of AI and advanced nuclear reactor design, paving the way for safer, more efficient data-driven nuclear power solutions. More high-quality Research Topics and articles are welcomed to this open platform in the future. All the editors are open to further information and communications.

## Author contributions

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