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Improving Monte Carlo shielding calculations by learning the importance map

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Reference shielding calculations are usually performed with Monte Carlo codes. When simulating rare events with Monte Carlo methods, it is necessary to use variance reduction techniques to reduce the statistical uncertainty on the expected result. Most of these techniques require a prior knowledge of the problem in the form of a so-called importance map, which represents the average contribution to the score as a function of the phase space coordinates. An initial guess for the map is usually generated by deterministic methods.

The aim of my PhD is to study the possibility to dynamically refine the importance map, and thus accelerate convergence, using the information generated by the simulation itself. To this goal, we use statistical learning algorithms, which have recently shown very good performance at recognizing patterns, approximating complex functions and managing large data sets. I will illustrate how the deterministic ansatz and the learning algorithms influence the performance of the Monte Carlo simulation.

Auteur principal: NOWAK, Michel (CEA)

Orateur: NOWAK, Michel (CEA)

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