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Learning of the importance map in a direct Monte Carlo shielding calculation with the particle transport code TRIPOLI-4(R)

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TRIPOLI-4® is a Monte Carlo code that simulates the transport of particles (Neutrons, Photons, Electrons) and provides reference solutions that are used to validate faster deterministic codes. In radiation shielding studies, engineers use Monte-Carlo codes to estimate radiation doses rate due to radioactive sources, given a description of the problem geometry. However, Monte Carlo methods may converge very slowly if the score of interest (i.e. the dose rate) is dominated by rare events.

Therefore, 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 an estimate of the likelihood that a particle will contribute to the score as a function of its phase space coordinates. The map helps the code to choose which particles are likely to contribute to the score and therefore worth simulating. The aim of this work is to improve the figure of merit of a Monte Carlo run by learning from histories of events with Machine Learning algorithms.

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