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A Method to Alleviate the Long History Problem Encountered in Monte Carlo Simulations via Weight Window Variance Reduction

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Implementing weight window (WW) is a usual method for variance reduction (VR) of Monte Carlo simulation, however as for a complex and large model simulation it frequently encounter the long histories (LH in abbreviation) problem in parallel computing. LH behavior shows as the running time of a single particle history is significantly longer than that of normal histories. It would take a disproportionate amount of time for Monte Carlo simulation to accomplish and place a detrimental effect on the efficiency of parallel computing. In this paper, the investigation of reason that causing LH was carried out firstly. A simple dog-log model was constructed to observe and analyze the LH phenomenon. Then comparative tests were carried out on a 3D model of the Chinese Fusion Engineering Testing Reactor (CFETR) with three approaches these are: a) analog running without any VR techniques; b) normal weight window VR technique; c) a novel approach proposed in this paper of limitation of weight window splitting. The results show that a suitable set of parameters in the improved WW module significantly improves the efficiency of variance reduction performance in parallel calculation, making the long history problem tractable without biasing results.

Eligible for student paper award?

No

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