NEW METHODS FOR THE MONTE CARLO SIMULATION OF NEUTRON NOISE EXPERIMENTS

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ABSTRACT

This paper presents two improvements to speed up the Monte-Carlo simulation of neutron noise experiments. The first one is to separate the actual Monte Carlo transport calculation from the digital signal processing routines, while the second is to introduce non-analogue techniques to improve the efficiency of the Monte Carlo calculation. For the latter method, adaptations to the theory of neutron noise experiments were made to account for the distortion of the higher-moments of the calculated neutron noise. Calculations were performed to test the feasibility of the above outlined scheme and to demonstrate the advantages of the application of the track length estimator. It is shown that the modifications improve the efficiency of these calculations to a high extent, which turns the Monte Carlo method into a powerful tool for the development and design of on-line reactivity measurement systems for ADS.

Key Words: Monte Carlo, noise analysis, Feynman-α, autocorrelation, ADS

1. INTRODUCTION

At present accelerator driven systems (ADS) are being studied, because of their attractive features with regard to safety and transmutation. A crucial point for the practical realization of ADS is the development of a reliable method to monitor the reactivity of the core. Among others, neutron noise methods such as Feynman-α and Rossi-α measurements are being proposed for this, and experiments like the MUSE project are being conducted to investigate how these techniques can be applied to ADS. Furthermore, new theories are being developed to describe these methods in a more sophisticated way with special attention to spatial, spectral and temporal effects. The development of computer codes that can assist in the design and analysis of reactivity measurement systems has outstanding importance.

Conventional Monte-Carlo codes applying variance reduction techniques are not applicable, because the behavior of the neutron noise depends on the collective effects of particles, which can be only estimated by so-called non-Boltzmann tallies [1], and furthermore is influenced by