Joint seminar with
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Neutron Noise Analysis using the Basic Element Method

Abstract

The neutron noise spectra in nuclear reactors are a convolution of multiple induced reactions. In the case of the IBR-2M pulsed reactor (JINR-Dubna), neutron noise is a random change in the pulse energy. Part of the spectrum of neutron noise IBR-2M is caused by fluctuations in reactivity associated with vibrations of mobile reflectors (fast noise component), part - with other moderately stable sources. Under normal operating conditions of the reactor, the full range of noise of the IBR-2M reaches ± 22%. Therefore, slow changes in the average power, the so-called basic components of the power, due, for example, to the movement of the regulating bodies, actually "drown" in neutron noise. However, in a number of cases, these are basic signals that are of fundamental importance for justifying the conditions for the safe operation of the reactor. And the question is how to correctly isolate these basis signals from the general chaos of successive values of pulse energy.

A sixth order accuracy Mean-Square Piecewise Approximation (MSPA-6) algorithm for the resolving a baseline component out of the IBR-2M noise is proposed. It is built with the help of the basic element method (BEM) developed at LIT JINR. The algorithm depends on four control parameters (α, β, K, M). The optimal values of the local parameters α, β, M and of the global parameter K were determined in such a way that the baseline (the activity of the control rods) did not fall into the noise spectrum and did not suppress its low-frequency components.

The BEM-algorithm was applied to both static and dynamic states of the reactor in the 0 - 2 MW power range. The average processing time of one point on a PC x86_64 Intel Core i5-4570 Sandy Bridge processor, 3.20 GHz was approximately 0.05 ms, which allows using the BEM algorithm in real time.