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Calculation of Core Axial Power Shapes Using Alternating Conditional Expectation Algorithm

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Abstract

We have introduced the alternating conditional expectation (ACE) algorithm in the method of reconstructing 20 node axial power shapes from five level detector powers. The ACE algorithm was used to find the optimal relationships between each plane power and normalized five detector powers. The obtained all optimal transformations had simple forms to be represented with polynomials. The reference axial power shapes and simulated detector powers were drawn out of the 3-dimensional results of Reactor Operation and Control Simulation (ROCS) code for various core states. By the ACE algorithm, we obtained the optimal relationship between dependent variable plane power, y, and independent variable detector powers, {Di, i=1,...,5} without any preprocessing, where a total of ~3490 data sets per each cycle of YongGwang Nuclear (YGN) Power Plant units 3&4 are used. To test the validity and accuracy of the new method, about 21,200 cases of reconstructed axial power shapes are compared to original ROCS axial power shapes, and they are also contrasted with those obtained by Fourier fitting method (FFM). The average error of root mean square (rms), axial peak (DFZ), and axial shape index (DASI) of our new method for total 21204 data cases are 0.81%, 0.51% and 0.00204, while FFM 2.29%, 2.37% and 0.00264, respectively. The evaluation results for the data sets not used in the ACE transformations also show that the accuracy of new method is much better than that of FFM.