OECD/NEA WPNCS

Expert Group on Monte Carlo Source Convergence

in Criticality Safety Analysis

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Chronological Fission Source Convergence Bibliographie

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- "Monte Carlo Methods for Equilibrium Solutions in Neutron Multiplication," by E. L. Kaplan, UCRL-5275-T, Lawrence Livermore National Laboratory (1958).). Using the fission matrix calculation as a separate and faster calculation. Success limited by noise.

- "An Analysis of Variance Test for Normality", by Shapiro and Wilk, *Biometrika*, Vol. 52, p591 (1965). Presents a test for normality of random samples.

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- "On the Markov Chain Analysis of Source Iteration Monte Carlo Procedures for Criticality Problems: II", by T. Elperin and A. Dubi, *Nucl. Sci. Eng.*, **91**, 77 (1985). Evaluates Monte Carlo fundamental mode bias.

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- "Computation of Standard Deviations in Eigenvalue Calculations,", by E. M. Gelbard and R. E. Prael, *Proceedings of the International Monte Carlo Methods for Neutron and Photon Transport Calculations Conference*, September 25-28, 1990, Budapest, Hungary.). The batching method for correcting uncertainty estimates is evaluated. The tradeoff between fewer large batches (reduced autocorrelation at the expense of a smaller sample size) and more small batches (a larger sample size with greater autocorrelation) is identified.

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- "Monte Carlo Criticality Source Convergence in a Loosely Coupled Fuel Storage System", by Roger Blomquist and Ely Gelbard, *Proceedings of the Seventh International Conference on Nuclear Criticality Safety,* Vol. II, 500-507 Tokai, Ibaraki, Japan, October 20-24, 2003. Describes the failure of 5 statistical tests (one a new fitted drift test) to detect incomplete convergence in the checkerboard problem.

- "Automated Suppression of the Initial Transient in Monte Carlo Calculations based on Stationarity Detection using the Brownian Bridge Theory", by Y. Richet, O. Jacquet and X. Bay, *Proceedings of the Seventh International Conference on Nuclear Criticality Safety*, Vol. II, 578-583, Tokai, Ibaraki, Japan, October 20-24, 2003. A post-processing method to determine how many early generations to ignore. Works even when no trend is visually detectable. Vassilacopoulos (based on the ranks bridge) and Schruben (based on the series bridge) statistics. The accuracy of a criticality Monte Carlo calculation requires the convergence of the keffective series. Once the convergence is reached, the estimation of the keffective eigenvalue must exclude the initial transient of the k-effective series. The present paper deals with a postprocessing algorithm to suppress the initial transient of a criticality MC calculation, using the Brownian Bridge theory. This study on bridges based statistical tests shows good results in terms of transient bias gains, and even when transients are not visible to the naked eye. This preliminary study on automated transient suppression allowed to validate the iterative truncation methodology and some stationarity tests.

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- "The Sandwich Method for Determining Source Convergence in Monte Carlo Calculation", by Y. NAITO and J. YANG. Journal of NUCLEAR SCIENCE and TECHNOLOGY, VOL.41,No.5, (May 2004) The essence of the method is that a finally converged eigenvalue keff is approached starting from two kinds of initial source guesses which give higher and lower neutron multiplication factors. By this method, a range of a finally converged keff is estimated.

- "Entropy of the Fission Source Distribution & Stationarity Diagnostics", F. B. Brown and R. D. Mosteller. 9 very informative slides from Advances in Monte Carlo Criticality Calculations Workshop, mentioned in I above. Examples with some theory, examples and results including OECD/NEA source convergence problems.

- "Monte Carlo Criticality Calculations - Power Iteration, Convergence & Wielandt's Method", F. B. Brown and R. D. Mosteller. 27 very informative slides from Advances in Monte Carlo Criticality Calculations Workshop, mentioned in I above. Theoretical description of power iteration, Wielandt and Superhistory methods. Several references, four of which are not on our list (the first three are k-eff Monte Carlo, maybe not so much source convergence): Mendelson NSE 1968, Rief and Kschwendt NSE 1967, Goad and Johnston NSE 1959 and Nakamura 1986 (book, under Wielandt Method).

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- "Convergence Criterion of Fundamental Mode Fission Source Distribution in Monte Carlo Calculations", H. J. Shim, C. H. Kim, >From 2005 MC meeting in Chattanooga, see II above.

- "Vacation Matrix Method for Correct Source Distribution in Monte Carlo Criticality Calculations", J. P. Finch, J. S. Hendricks, C. K. Choi, From 2005 MC meeting in Chattanooga, see II above.

- "Asymptotic Equipartition Property and Undersampling Diagnostics in Monte Carlo Criticality Calculation", T. Ueki, From 2005 MC meeting in Chattanooga, see II above.

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