UNIVERSITY OF BIRMINGHAM

MSc. PHYSICS AND TECHNOLOGY OF NUCLEAR REACTORS

Developing a genetic algorithm for the unfolding of neutron energy spectra

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Abstract: This thesis reports on the design, optimisation and testing of a custom Genetic Algorithm, which aims to solve the often ill-conditioned problem of neutron energy spectrum unfolding from activation foil detector data. The Genetic Algorithm uses principles from evolutionary biology to randomly create a population of possible neutron energy spectra and allows the population to breed, die and mutate over a number of generations. The algorithm was tested using a range of reference neutron energy spectra relevant to nuclear fusion coupled with a set of response functions for the VERDI and TBMD activation foil detectors currently being developed by the Culham Centre for Fusion Energy (CCFE). The algorithm was shown to solve the inverse matrix problem to unfold the neutron energy spectra in simple test cases performed reasonably well when the number of energy groups were comparable to the number of reaction rates in the activation detector, but less well when the neutron spectrum rose or fell sharply over a large logarithmic range or had too many energy groups.

This thesis has been submitted in partial fulfilment of the requirements for the degree of MSc in Physics & Technology of Nuclear Reactors