Applied Reactor Physics

TARGET AUDIENCE

Applied Reactor Physics is designed for an audience at the graduate level, without preliminary knowledge of reactor physics. A number of excellent textbooks exist at the undergraduate level but many graduate-level textbooks are out-of-print or are based on the four-factor formula, an obsolete approach. This book was primarily written as support for graduate-level courses given in the regular program of the Institut de génie nucléaire at École Polytechnique de Montréal, introducing state-of-the-art approaches. Enough material is included for constructing three or four graduate courses.

Most production codes in reactor physics are accompanied with rather complete theory guides, but the reader is assumed to be familiar with fundamental information not easily available. *Applied Reactor Physics* was also written to fill that need.

ORIGINALITY

A characteristic of this book is to emphasize the algorithmic nature of numerical solution techniques used in reactor physics. Many numerical solution approaches described in the book are accompanied by Matlab scripts and readers are encouraged to write short Matlab scripts of their own in order to solve the End-of-Chapter exercises.

A complete chapter is devoted to lattice code physics, representing an important but relatively obscure component of production calculations.

Typical numerical solution approaches are proposed to the reader for building small lattice or reactor physics applications. The precise selection of the numerical techniques is based on their legacy characteristics.

SUBJECT TREATMENT

Reactor physics is the discipline devoted to the study of interactions between neutrons and matter in a nuclear reactor. Such an interaction is produced when a neutron collides with the nucleus of a specific nuclide (or isotope). In this book, interactions between neutrons and nuclei are described by nuclear physics models as a function of neutron energy and nuclide characteristics. A statistical mechanics approach is also used to describe the distribution of neutrons in phase space (position and velocity vectors) as a function of time. The neutron number density (or neutron distribution) is the solution of a *transport equation*. This solution can be obtained using a variety of numerical techniques, as described in the book.

Reactor physics is approached from the fundamental level, assuming no preliminary knowledge of this discipline. Legacy numerical techniques are introduced with sufficient details to permit their implementation in Matlab. More advanced and/or proprietary techniques may be available in a production environment, but these can be obtained as evolutions of the fundamental approaches presented in the book.

AUTHOR

Alain Hébert has been a professor of the Institut de génie nucléaire at École Polytechnique de Montréal since 1981. From 1995 to 2001, he worked at the Commissariat à l'Énergie Atomique, located in Saclay, France. During this period, he led the development team of the APOLLO2 lattice code, an important component of the Science™ and Arcadia™ packages at Areva. Back in Montréal, he participated in the development of the DRAGON lattice and TRIVAC reactor codes, both available as Open Source software.

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