A Review of RSICC Software For Medical and Health Physis

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ND 2007, Nice, France April 22-27, 2007

Abstract

Every year the United States government spends hundreds of millions of dollars in biomedical research. Oftentimes the products of the research are computer codes. There is an unprecedented need to keep many of these codes 'alive' because they become the tools and foundations of future research. The Radiation Safety Information Center (RSICC) at Oak Ridge National Laboratory has been in the business of software maintenance, testing, and evaluation in the field of radiation transport and has promoted software development in the area of radiation transport for the last forty years. As a result, radiation transport software tools have been very useful in dose estimation and shielding applications.

Introduction

RSICC's history as a center for the quality control of scientific software goes back to 1963, when it was established as an Information Analysis Center (IAC). It was then called Radiation Shielding Information Center (RSIC). Panel No. 6 (Information Analysis and Data Centers) of the Committee on Scientific and Technical Information (COSATI) of the Federal Council for Science and Technology adopted the following definition [1]:

> *"An Information Analysis Center is a formally structured organizational unit specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing, and synthesizing a body of information in a clearly defined specialized field or pertaining to a specified mission with the intent of compiling, digesting, repackaging, or otherwise organizing and presenting pertinent information in a form most authoritative, timely, and useful to a society of peers and management."*

In 1997, RSIC was named Radiation Safety Information Computational Center (RSICC) to better fit the stronger role in computational applications.

RSICC's original mission was to provide in-depth coverage of the radiation transport field to meet the needs of the international shielding community. Today, RSICC collects, organizes, evaluates and disseminates technical information (software and nuclear data) involving the transport of neutral and charged particle radiation, and shielding and protection from the radiation associated with: nuclear weapons and materials, fission and fusion reactors, outer space applications, accelerators, medical facilities, and nuclear waste management. The Center provides in-depth coverage of radiation transport topics.

Specifically, RSICC was founded in order to solve the problem of availability and user support for the software produced by the Department of Energy's (DOE) nuclear research complex. Use and re-use of the valuable measured nuclear cross section data and the software, developed to model the transport of neutrons and gamma rays, was the primary concern of RSICC in the beginning. As it grew into a world recognized center, international agencies—including the Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA)—have contributed their software and data to the collection of over 1700 software packages.

The concept of the "live" code package is basic to the RSICC philosophy of serving the user community. When a code is packaged, lines of communication are kept open with the contributor and with users. Proposed corrections by users, after being verified by the original contributor, and additions and modifications are made to the code package as long as the program is of interest. The user is encouraged to, and often does, feed back into the center the results of the conversion and/or modification/extension efforts.

In the forty years of its existence, RSICC has established itself as a repository for codes and data libraries in the area of radiation transport supporting research and development in fission and fusion reactors, outer space applications, accelerators, weapons, medical facilities, and nuclear waste management and varied medical applications, especially in radiation therapy modeling.

An RSICC "package" consists of:

- Abstract
- Source code
- Sample problem input
- Sample problem output
- Documentation
- Executable program

RSICC packages are categorized according to:

- Computer Code Collection (CCC),
- Peripheral Science Routine (PSR),
- Data Library Collection (DLC)

Software that tracks particles (neutrons, photons, protons, electrons, etc.) is classified as "CCC". Software that does not directly track particles, but is used as a tool, for example plotting, is classified as "PSR". Nuclear cross section data form the "DLC" collection.

Medical and Health Physics Software

The paper is a synopsis of various computer code and nuclear data packages, maintained, tested and distributed by RSICC, used for medical and health physics dosimetry applications. The information is a subset of the total RSICC collection (see the RSICC web site http://rsicc.ornl.gov).

The software and data packages are discussed in several categories.

Radiation transport, shielding, and supporting codes for radiation therapy

CEPXS/ONELD 1.0
DOORS 3.2
EGS4
ETRAN
ITS 3.0
MCNP/MCNPX
MRIPP 1.0
PENELOPE
QAD-CGGP-A
SABRINA 3.54
TART

Codes devoted to medical X-ray calculations

BRHGAM
CALKUX
KUX
NCRP49
XSHLD

Codes for internal dose calculations

MILDOSE 3.1
RBD

Data collections and supporting codes useful in nuclear medicine

EDISTR
NUCDECAY
NucDecayCalc

Codes and data collections dealing with the microdosimetry of radiation therapy

ALDOSE
ICOM
UMIBIO

The application areas of the software include:

- Dosimetry calculations for radiation therapy
- Treatment planning in radiation oncology
- Design of photon and secondary neutron shielding for therapy rooms
- Evaluating and estimating patient and staff radiation dose
- Electron beam transport and energy deposition
- Secondary gamma transport and energy deposition

- Secondary neutron transport and energy deposition
- Cancer brachytherapy dosimetry
- Medical imaging applications, including SPECT, PET, and x-ray imaging
- Accurate physics and geometry models
- Body composition research
- Data in variance reductions for radiation oncology
- Error evaluations for accelerator particle delivery systems
- Diagnostic imaging
- Modalities of treatment and exploration of alternatives
- Licensing and safety analysis for medical radiation facilities
- Clinical radiation transport
- Dosimetric consequences
- Medical diagnostics and therapy
- Experimental benchmarks in medical physics model and data validation
- Determination of medical linear accelerators (LINAC) source spectra, and scattered radiation from LINAC head

References

[1] Proceedings of the Forum of Federally Supported Information Analysis Centers, November 7-8, 1967, PF 177051.

[2] U.S. President's Science Advisory Committee, Science, Government, and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information, (commonly known as the Weinberg Report), U.S. Government Printing Office, Jan. 10, 1963, 55p.