

NENG 685, Fall 17
Introduction to MCNP
November 17th and 20th, 2017

These course notes take a different approach to previous notes. Instead of being explicit, key concepts are listed with references back to the MCNP manual. This avoids duplication on my part, but more importantly, it gets everyone into the manuals, which is a must for continued use of MCNP. All of the page numbers listed are the pdf pg # from the MCNP6 manual (v1.0 Rev0) for easy browsing unless otherwise noted. This manual is included in the directory for these course notes.

Learning Objectives

After the class and assignments related to this material, you should be able to

1. Develop your own geometry for simple radiation transport problems.
2. Create a source that replicates physical sources using built-ins and basic distributions.
3. Define tallies for flux and reaction rates.
4. Modify the simulation physics
5. Run criticality calculations
6. Interpret the MCNP output

Input Structure

The basic input deck structure is specified as (pg 22):

One line problem title card

blank line delimiter

Cell cards

blank line delimiter

Surface cards

blank line delimiter

Data Cards

blank line delimiter (optional)

The complete MCNP input is referred to as a deck. Each line in the deck is a card.

The input deck is a bit backwards in terms of how you would actually build a deck from scratch, so I'll meander around the deck in the order I find the most logical.

Surfaces

Material definitions are discussed starting on pg. 112. Some key concepts:

- Defining surfaces by equations (pg. 65-67)
- Reflective surfaces (pg. 66)
- Macrobodyes (pg. 73-79) and facets (pg. 79)

Materials

Surface are discussed starting on pg. 64. Some key concepts:

- ZAID specifiers (pg. 113; ; la-ur-13-21822 pg. 19)
- Cross-section libraries (pg. 745; la-ur-13-21822)
- Material specification (pg. 113-116)

Cells

Cells are discussed starting on pg. 62. Some key concepts:

- Cell specification (pg. 62-63)
- Surface “sense”
- Splitting/Roulette - i.e. importance (pg. 331-332)

Source Specification

Sources are discussed starting on pg. 177. Some key concepts:

- General SDEF specification (pg. 177-186)
- Information, probability, and bias - SI, SP, SB (pg. 194 - 200)
- Built-in distributions (pg. 197 - 199)

Tally Specifications

Tallies are discussed starting on pg. 233. Some key concepts:

- Standard tally specification (pg. 235-241)
- Energy modifiers (pg. 257 - 258)
- Angle modifiers (pg. 260 - 261)
- Tally multipliers (pg. 262 - 269)

Physics Specifications

Physics are discussed starting on pg. 126. Some key concepts:

- Mode (pg. 126 - 127)
- Particle physics (pg. 127 - 139)
- Cut cards (pg. 141 - 144)
- Physics models (pg. 147 - 157)

Output

Output is discussed starting on pg. 405.