MATH-H510 – Coding exercise no.1

Particle transport

Reminder: the choice of programming language is up to each group.

- Consider an infinite shielding wall on which a neutron beam is incident. Assume first that this wall is homogeneous. Scattering will be assumed isotropic.
  - Compute, via a simple Monte Carlo algorithm and for plausible values of the macroscopic cross sections, the transmission probability through this wall as a function of its thickness. Provide for each point a measure of the accuracy of your estimate (to be done for all estimations below as well!).
  - For selected values of this thickness, the sensitivity of this probability to the capture/scattering ratio will be analyzed.
  - For a sufficiently low value of the transmission probability, try to improve the efficiency of the Monte Carlo estimation by resorting to:
    - Antithetic variates
    - Various splitting strategies, that will be presented clearly in the report
    - Various biasing strategies (same comment)
    - A more efficient estimator than a counter when the transmission is occurring

  Provide a detailed analysis of the results obtained.
- In order to account for the variable properties of the concrete of the shielding wall, it is now assumed that the wall is made of several layers of different qualities of concrete, differing from one another by the values of the macroscopic cross sections they display. Explain how your Monte Carlo algorithm must be adapted to this new formulation of the problem, and redo some of the computations of the last black bullet point above to this case.

  How could you go back to a simple sampling approach of the free flights, and what should you pay attention to in this case? Compare the latter results to your first sampling approach.
- In a double randomization perspective, the number and thicknesses of the concrete layers as well as their neutronic characteristics are now considered as uncertain. Implement this approach, and compare with a few computations obtained in the previous problem.

Reporting

Provide a clear description of the algorithms used, the various versions of the code written, the procedure you adopted to define the different steps of the problem, as well as a detailed description of the results obtained.

The report should be sent to Mrs. Maureen CICCARELLI by December 6.