Michael Reichenberger

ME701 – Development of Computer Applications for Mechanical Engineering

Final Project Proposal

Dr. Roberts –

My primary objective going into class this semester was to become more familiar with developing Python code for my Monte Carlo simulations. As part of this objective, I hoped to learn how to design compiled Python code in order to speed up the simulation process.

Last semester I developed a novel Monte Carlo simulation method to estimate the neutron detection efficiency and pulse height spectra for porous materials. Previous methods of neutron transport simulation have not been able to accurately reproduce the random heterogeneities of these porous materials. As a first iteration, the code I developed was not incredibly clean. Any changes to the material parameters requires changes to the hard-coded values. Typically I will just create a copy of the entire set of files to make a small change. Additionally, the current simulation is compiled on-the-fly and takes a very long time to execute. A typical simulation for 106 histories will take ~30 minutes to execute. In order to obtain high fidelity estimates 108 histories are preferred.

I hope to re-build my porous material Monte Carlo simulation to accomplish 3 tasks:

1. Refine the internal flow of data. Right now I am passing a lot of unnecessary information around. I need to make sure that I am being efficient with my code. This will require me to analyze my current simulation and find areas to save data (and time).
2. Incorporate user input. I would like to be able to use at least 2 different geometry styles, with user input for all of the appropriate parameters. If time allows, I also want to provide an optimization option to allow the user to optimize a parameter for the selected material.
3. Compile the simulation into an executable file. The most important goal for me is to be able to hand this simulation package off to one of the other guys in the lab and allow them to run whatever simulations they want without needing to understand how to change variables in the code. By compiling the code, I will be able to deliver a package that anyone will be able to run, and also greatly speed up my simulation.

I will measure the success of these goal by:

1. Obtaining at least a 25% speed increase compared to the original simulation
2. Offer 2 geometries and appropriate parameters for user input
3. The final version should be executable from one of my co-workers’ computers

I will complete these tasks no later than 2014.12.19

Thank you,

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