MCSC6280: Particle Based Modeling and Simulation
Assignment 4

October 20, 2015

Important Notes
- do your own work
- please submit your material as a single archive file (e.g. *.zip)
- the title of the archive file you submit must contain your last name and the assignment number
- for each question I indicate what material must be submitted; although not explicitly stated, **you must also include a discussion of the results!** (ie, does the result make sense? why or why not?)

1. Energy Deposited in a Sample

Consider the following scenario:

i) N particles traveling in the $+x$ direction (you will want $N \geq 10^5$). All particles are at $x = 0$ at $t = 0$. The distribution of particle kinetic energies is uniform between 4.0 and 5.0 in arbitrary units (AU).

ii) At each time step, the particle either has an interaction or keeps traveling in $+x$.

iii) Interactions occur with a probability of $p = 0.05$ at each time step. If an interaction occurs, the particle loses 0.2 AU energy. This energy is deposited in the sample. No new particles are created in the interaction.

iv) If the particle does not have an interaction, it keeps traveling in $+x$ with a velocity given by its kinetic energy. In the absence of an interaction, the particle loses no energy and thus no energy is deposited.

v) This process repeats until a particle's energy is less than a threshold of 0.1 AU at which time we can consider the particle to no longer contribute significant energy such that they can be ignored.

vi) Other variables are set as follows: mass $m = 1$ and timestep $dt = 1$.

Write an agent based Monte Carlo program that can simulate particle trajectories according to these conditions. Submit a plot of the energy deposited in the sample as a function of x. You will have to bin the x coordinate to get an informative plot. Comment on the results!

Submit:
- your simulation code
- your plot of the histogram of energy deposited in the sample as a function of x
- your discussion of the results