Re: question about particle−wall collision simulation

Source: http://sci.tech−archive.net/Archive/sci.physics.particle/2005−11/msg00025.html

- *From*: maarten <invalid@xxxxxxxxxx>

- *Date*: Sat, 19 Nov 2005 11:05:47 +0100

PD wrote:

> A 2D model of a gas (which is what you have) simply has to require
> conservation of momentum (in both x and y directions) and conservation
> of kinetic energy in every collision.

That is what I do.

>
> The same thing is true for a wall.
>
> What this will yield, for example, for a y−wall (parallel to y−axis) at
> x=L/2, is that
> v_x(before) = −v_x(after)
> v_y(before) = v_y(after)

This is what I do for the walls that should not be there but are the
boundery of the simulation.

>
> This is for a case where the wall does not transact energy with the
> particle. This isn't perfect, even in the case where the gas is in
> thermal equilibrium with the wall, but it's close.

What's the difference? I assume there is a chaos element in the direction
and the energy?

> If you want to add
> thermal transactions with the wall, then the easiest thing to do is to
> treat every wall collision like the collision with another particle
> having kinetic energy equal to the average kinetic energy of the
> particles in the gas.

Sounds logical. I will try that.
I assume the avarage kinetic energy of the particles of a gas:
Ekin = 3/2*k*T
In which T is the temperature of the wall.
I will assume the the wall has that kinetic energy in the direction straight

from the wall. The the energy of the gas−particle after the collision can be calculated considering conservation of momentum and energy. Then the delta E for the wall can be seen as a delta Q which can be translated in a delta Twall.

I will try that. Meanwhile, I put the application on the web using webstart:
http://maarten.dootingh.nl/professioneel/heatConductionSimulation/hcsim.jnlp
HeatConductionOfGas.jar
Or you can download it: http://maarten.dootingh.nl/professioneel
heatConductionSimulation/HeatConductionOfGas.jar
This version uses an incorrect collision energy formula. You can see that the molecules get a lower temprature than the walls when molecule−molecule collsions occur. I hope this will be corrected once I implement the above molecule−wall collsion formula.

Thanks

>
> PD
>
>>
>> I tried the following:
>> 1) The direction of the particle after the collision is completely
>> random. The energy is such that the temperature is equal to the
>> temperature of the wall.
>> 2) The direction of the particle after the collsion is straight from the
>> wall. The energy is such that the temperature is equal to the temperature
>> of the wall.
>> 3) The direction of the particle is such that alpha_in=alpha_out. The
>> energy is such that the temperature is equal to the temperature of the
>> wall.
>>
>> All seem to work OK, with the exception that the 2nd option requires
>> enough particles for introducing enough chaos.
>>
>> Does sombody know whether it is good physics to simulate a particle−wall
>> collision this way? Or a website where I can find theory about this
>> topic?

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- ***References***:
  - ♦ ***question about particle−wall collision simulation***
    - ◊ *From:* maarten
  - ♦ ***Re: question about particle−wall collision simulation***
    - ◊ *From:* PD

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