Distributed Simulation of Billiard Balls Collision

(Project Report for Course COMP655)

Hongyan Song
(260153432)

McGill University
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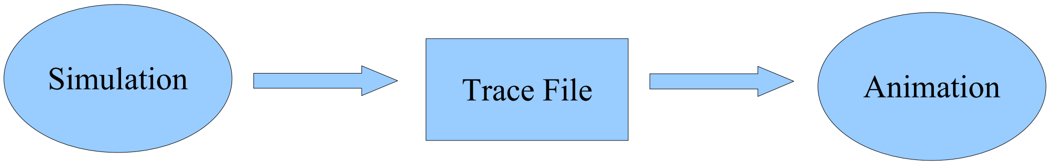
1. Architecture

The architecture of the system is as this. The billiard table are partitioned into parts, which I call sectors, each sector is simulated on separate processor. The communication between different processors are implemented by MPI. The simulation trace of each part is saved into corresponding XML file. And the animation program read the trace file and do the animation.



2. Events Modeled

For each sector, the following events are modeled:

Initial: initialize the billiard balls and sectors

Collision: two balls collide

Bounce: a ball bounces from the border of the table

Departure: a ball leaves current sector

Arrival: a ball arrives from a neighbor sector

3. Experiment Result

The result is taken from the following simulation environment. The billiard table are partitioned into two sectors, sector0 and sector1. Each is simulated on separate processor (machine). At the beginning, each sector has 20 balls, balls with number 1-20 are in sector0 and with number 21-40 in sector1.

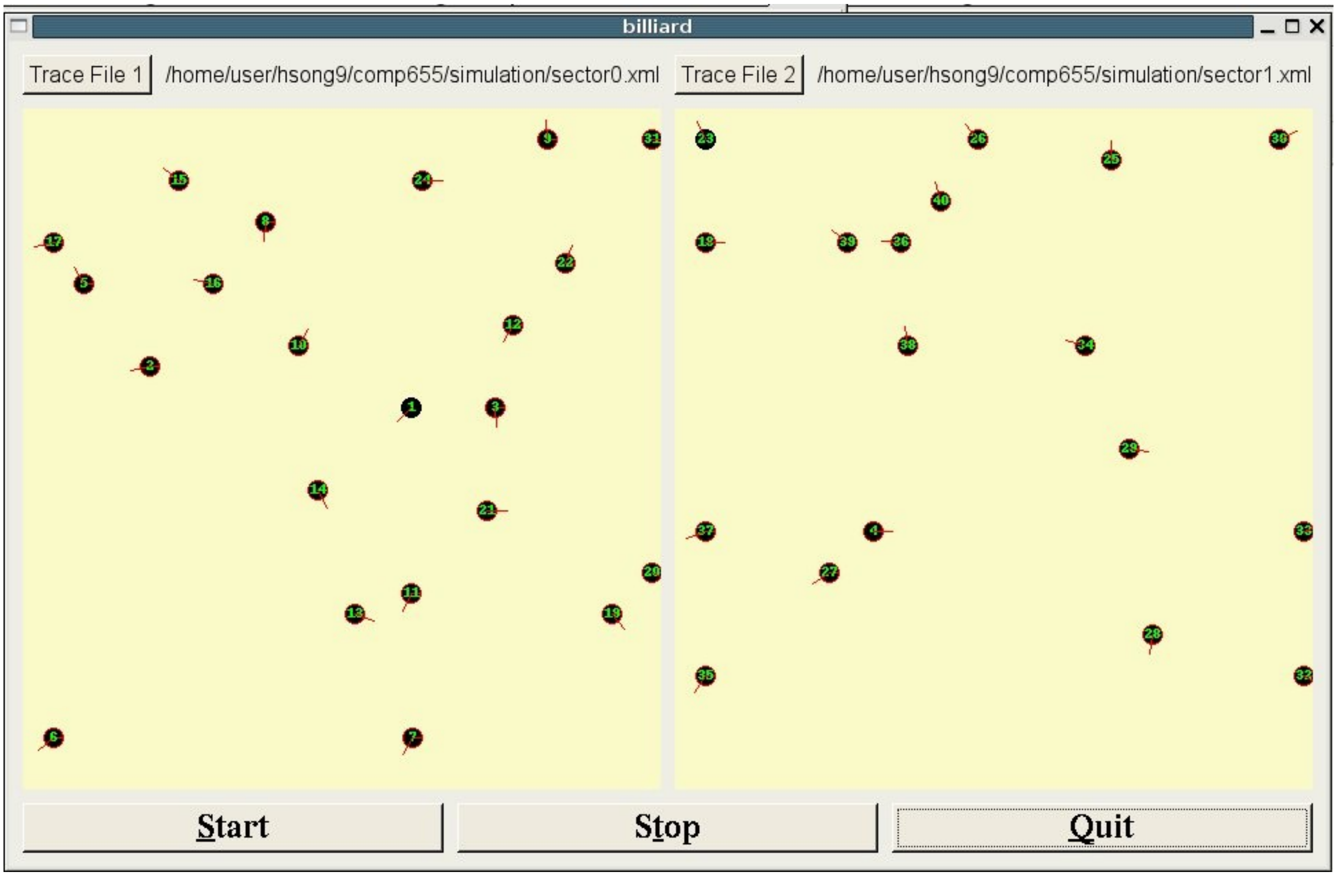
3.1 Sample of Trace File

The below is a sample state taken from “sector0.xml”. This is the state saved after a departure event (ball 4 leaves sector0) processed. Balls with id less than 20 are the balls originally in sector0, balls with id number higher than 20 are balls coming from sector1.

```
<event>
<time>2.0806</time>
<content>Departure;ball  4</content>
<ballstates>
        <ball id="1" v="2" angle="227" x="21.1621" y="11.0433"></ball>
        <ball id="2" v="3" angle="193" x="1" y="11.4041"></ball>
        .......
        <ball id="20" v="5" angle="333" x="28.7229" y="28.1007"></ball>
        <ball id="22" v="5.75528e-270" angle="2.122e-314" x="28.5577" y="7.38885"></ball>
        <ball id="24" v="5.75528e-270" angle="2.122e-314" x="27.6207" y="9.0497"></ball>
  </ballstates>
</event>
```

3.2. Screen Shot of Animation

The below is the screen shot for the trace animation. The left part animates sector0, and the right part animates sector1. The number on each ball has the same meaning as above. And the segment on each ball marks the direction of the velocity.



Trace File 1 /home/user/hsong9/comp655/simulation/sector0.xml

Trace File 2 /home/user/hsong9/comp655/simulation/sector1.xml

4. Operation Guide

1. go to the simulation directory, type “mpirun -machinefile machines.LINUX -np 2 hello”
2. go to the animation directory, type “./billiard”

If you want to recompile the source files, just type “make” in the corresponding directory.