Comparison 12 – MATLAB/SIMULINK

Continuous Approach – State Events

MATLAB is a widely used software tool based on numerical vector and matrix manipulation. SIMULINK is a continuous simulator with a graphical user-interface, embedded in the MATLAB environment.

Model description: MATLAB provides the speed and the positions of the balls, then calling a SIMULINK model (fig. 1) that runs as far as the next hit (state event). The calculations at the hit are done in MATLAB, which then starts the model again, until finally all relative speeds are positive.

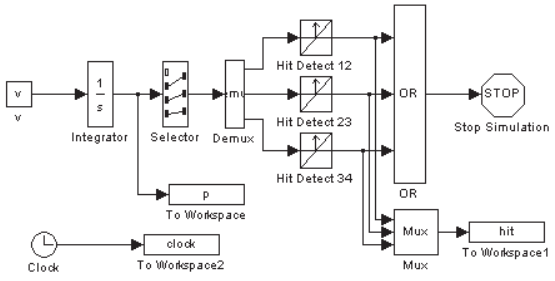

fig. 1: SIMULINK model

Task a

1. Relative positions were only stored at each hit event (fig. 2). This makes sense, because the functions are linear between hits. Finally the spheres move with nearly no distance.
2. `e=1: v=0; 0; 0; 1`
   `e=0.171577: v= 0.25; 0.25; 0.25; 0.25`
   `0.171577` was the smallest value of `e` to be used for simulation. Smaller values would result in never-ending simulation runs.

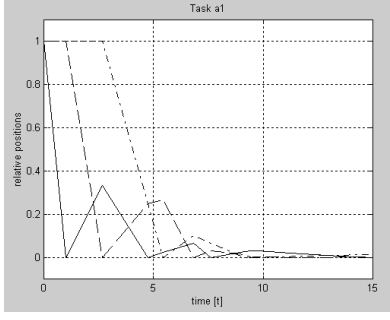

fig. 2: Task a1

Task b: Simulation runs were performed for values of e from 1 to 0.171577. The final speeds behave like expected, but the tremendous increase in hits is interesting. This is what makes solving the system a numerical problem for small values of e.

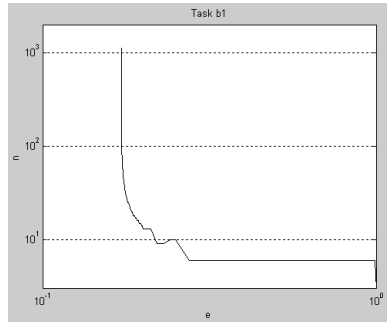

fig. 3: Task b1

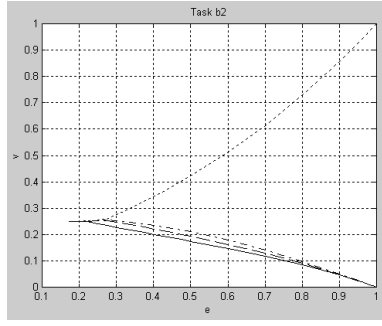

fig. 4: Task b2

Task c: The solutions for this task were generated by means of built-in MATLAB functions.

1. e = 0.5865 gives $v_4 = 0.4991$
2. mean: 0.4214
   std. deviation: 0.03973
   95% confidence interval: [0.3449; 0.5004]
   Although the histogram (Fig. 5) looks very similar to a normal distribution, it is clearly nonsymmetric, which is why the confidence interval is also nonsymmetric.

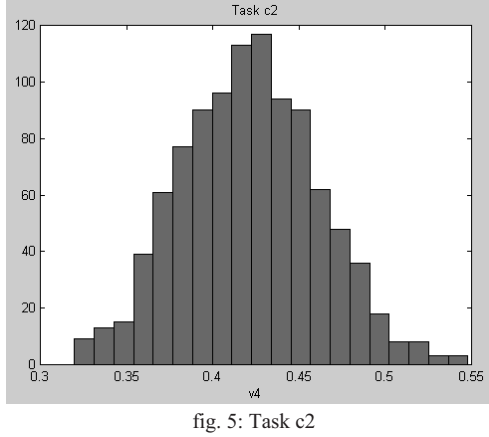

fig. 5: Task c2

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