Simulation Engineering Exercises 02

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1. Develop a simple Pendulum Simulation

Assumptions:
Since it is so lighter than the artist, mass of the string is ignored.
Friction within the string is ignored.
Since the artist moves slow, air resistance is ignored.
In this simple simulation, the length of the string does not change.

Mathematical Model:
a) $\sum F_{tan} = ma_{tan}$
b) $-\mathrm{mg}\sin\theta = ma_{tan} = mL\ddot{\theta}$

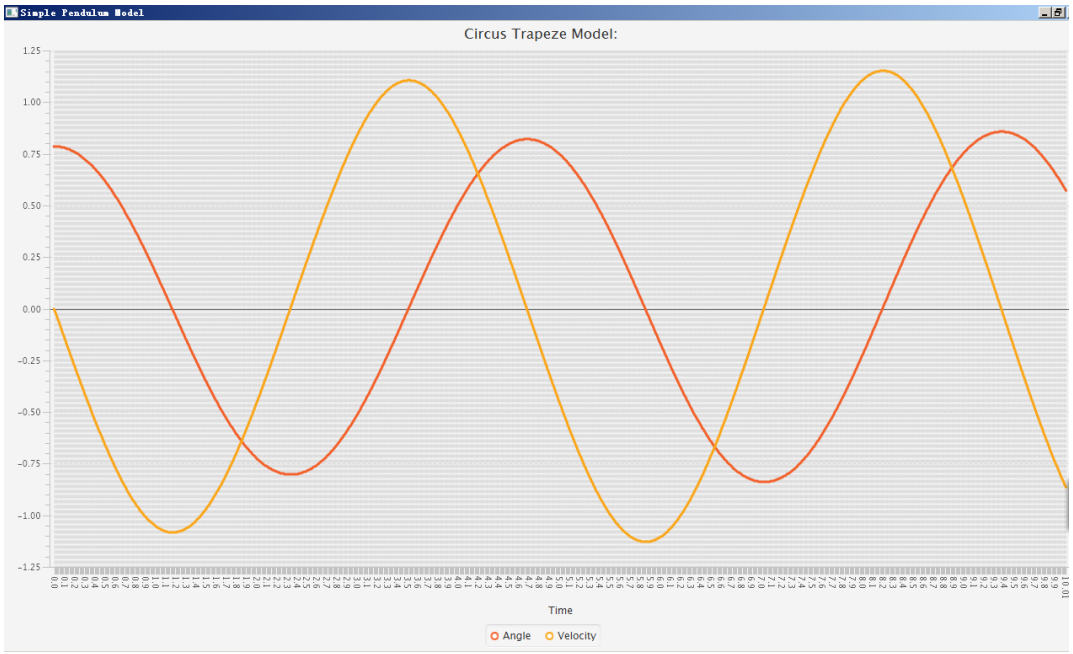
Main code:

```
public void start(int run_mode) {

    //
    double t = start_time;
    double th = init_theta;
    double th_v = init_theta_v;
    state = new AcrobatState(t, th, th_v);
    state_list.add(state);

    if (run_mode == STATUS_STATIC) {
        while (t <= end_time) {
            double th_temp = th;
            th = th + th_v * delta_time;
            th_v += (-g / l * Math.sin(th_temp)) * delta_time;
            t += delta_time;
            state = new AcrobatState(Math.round(t * 1000) / 1000.0, th, th_v);
            state_list.add(state);
        }
    } else if (run_mode == STATUS_DYNAMIC) {
        ;
    }

}
```

```
public void outputResult() {
    for (int i = 0; i < state_list.size(); i++) {
        System.out.print("Time: " + state_list.get(i).getTime() + ", ");
        System.out.println("Theta: " + state_list.get(i).getAngle() + ","
                + Math.toDegrees(state_list.get(i).getAngle()) + ".");
    }
}
```

(run_mode==STATUS_STATIC)

Graph:



Output results:

Simple Circus Trapeze Output.txt

2. Develop a complex Pendulum Simulation

Assumptions:

It is the same as the simple one.

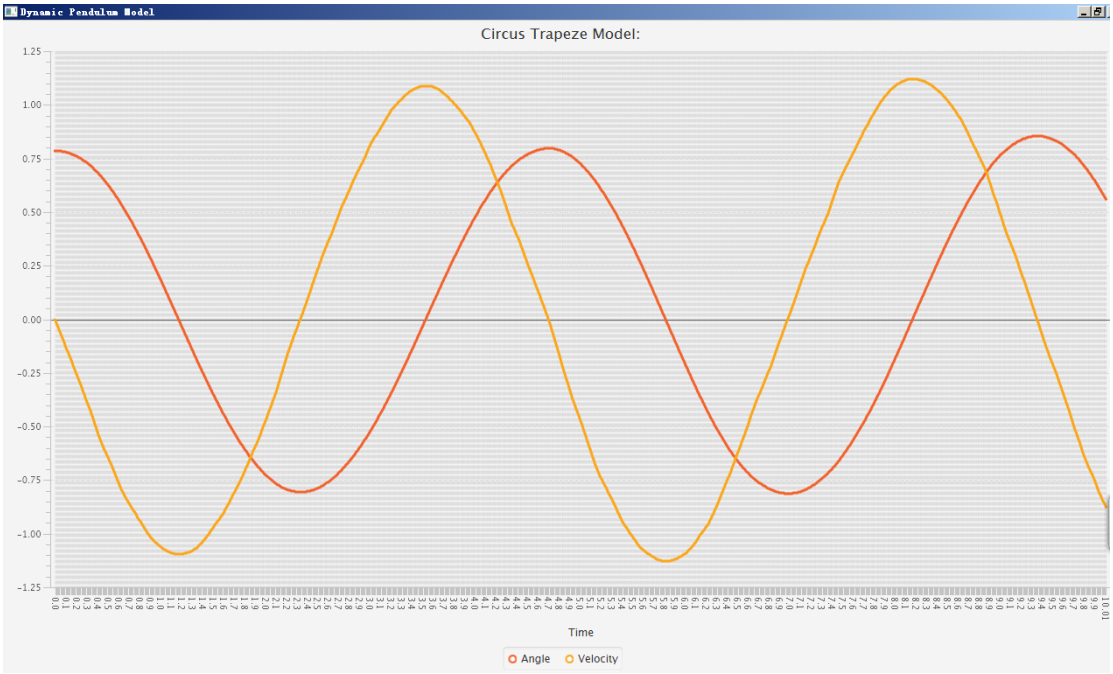
But the length of the string would change.

Main code:

```
} else if (run_mode == STATUS_DYNAMIC) {
    Random r = new Random();
    while (t <= end_time) {
        if (r.nextInt(10) > 7) {
            if (l > LEIGHT) {
                l -= h / 2;
            } else {
                l += h / 2;
            }
        }
        double th_temp = th;
        th = th + th_v * delta_time;
        th_v += (-g / l * Math.sin(th_temp)) * delta_time;
        t += delta_time;
        state = new AcrobatState(Math.round(t * 1000) / 1000.0, th, th_v);
        state_list.add(state);
    }
}
```

(run_mode==STATUS_DYNAMIC)

Graph:



Output results:

Complex Circus Trapeze Output.txt

Code:

https://github.com/sampig/SimulationEngineering