Simulation Part II

ES100

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Points of Discussion

- Review of project overview and goals
- Logic Review
- Report Example
- Extra Credit
- Textbook Problem Omissions

Textbook Problem Omissions

- Omit Problems:

  6.4-2

  6.4-3

  6.4-7

  6.6-3

Extra Credit Guidelines

- The extra credit will be worth 10 pts
- Register with instructor before next Monday's lecture, April 19th
- The extra credit problem will be graded on an, *all or nothing* basis.
- The work is due on Monday, April 26
- The problem assigned for extra credit is 6.3-3, parts a and b.

Simulation Overview

- Simulate the performance of a wheeled vehicle over a given road course.
- Evaluate the vehicle's performance in terms of time and energy expense required for the vehicle to complete the course
- Execute a parametric study of performance vs. vehicle characteristics, *i.e. vehicle mass*, *drag area*
- Report results using standard engineering protocol in a modestly comprehensive written report

roaddata.txt format

Distance [km]	Grade [°]	Speed [km/h]	Event Code	Time Duration, [s]
0	0	48.4	0	0
10.0	0	72.5	0	0
125.0	0	32.2	1.0	10.0
200.0	-5.0	32.2	0	0
250.0	0	0	2.0	0

Event Code Definitions

`if` the event code value, **`ecv== 0`**,

then the vehicle continues for the specified time duration

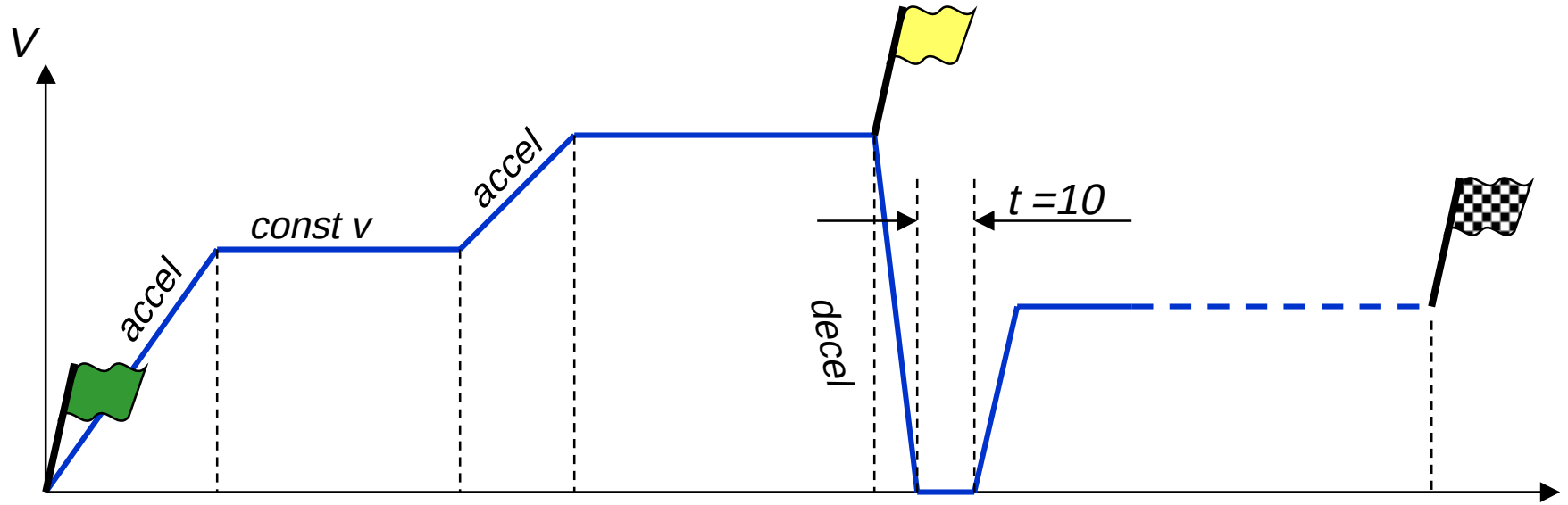
`if ecv==1`,

then the vehicle should stop for the specified time duration

`if ecv==2`,

then the vehicle has reached the end of the course

Velocity vs. Time



t=0	t=?	t=?	t=?	t=?	t=?
v=0	v=48.4	v=48.4	v=72.5	v=72.5	v=32.2
x=0	x=?	x=10	x=?	x=125	x=250

Possible Code Logic Outline

```
i=1;
while event(i) < 2   %car is on course
   if event(i) == 0   %then car is moving
      while x < distance(i+1)
         if v < speed(i)
            %then accelerate vehicle
         elseif v > speed(i)
            %then decelerate vehicle
         else
            %then move vehicle at constant
            %velocity
         end   %if
      end   %while
   else   %then i=1 and car is stopped
      %wait for duration(i) seconds
   end   %if
   i=i+1;
end   %while
```

Simplified Problem

- Often times in engineering it is necessary to begin a complex problem by starting with a simplified case. Then the answer is refined by adding complexity to the simple case.
- This approach could be applied to the simulation by concerning ourselves only with the force due to gravity to begin with. Then the additional forces can be added on to the working code with relative ease.

Summary of Equations

$$T - F = M_e \frac{dV}{dt}$$

$$\frac{dV}{dt} = \frac{V_{j+1} - V_j}{t_{step}}$$

$$F = W \sin\lambda + R + D$$

$$R = W(\mu_1 \cos\lambda + \mu_2 V)$$

$$D = \tfrac{1}{2} C_d \rho A V^2$$

Report Writing

- Refer to the link on the web page for an engineering report example.

http://www.clarkson.edu/~es100mae/report_jm.pdf