COMPUTATIONAL PHYSICS (SSP2122)

Restoring Force

by

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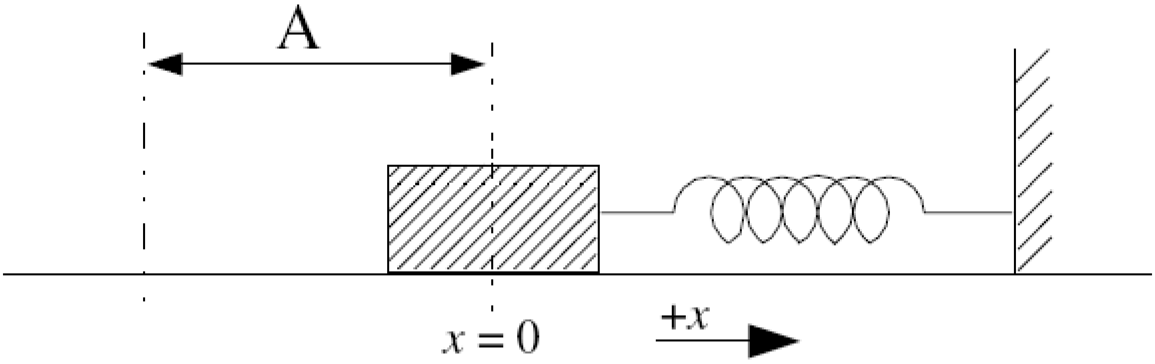
Damped Harmonic Oscillation



Object *m* is on a flat surface attached to a spring as in figure above. The object is pulled to position A, and released so that it oscillates about *x*=0. Assuming that the force *F =ma= -bv-kx*, where *x* is position of the object, *v* is the velocity, *k* the spring constant, and *b* is a constant associated with friction with the flat surface.

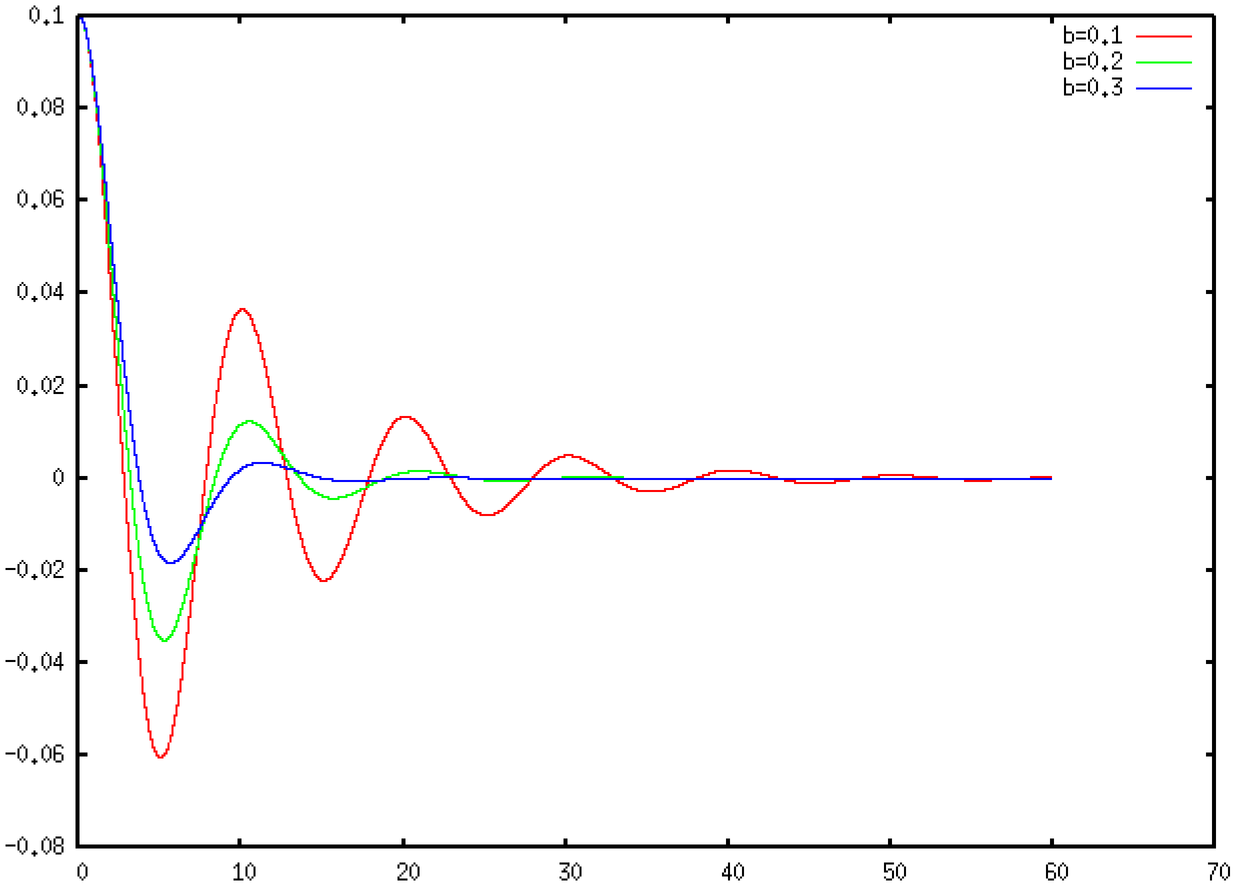
The algorithm :

1. Declare the class/method to be used
2. Declare and assign all variables to be used;
   x, t, delt, k, b, A, m, F, a, v, v0 and x0;
3. Declare and assign constants to the respective variables;
   k = 0.2, b = 0.1, A = 0.1, m = 0.5;
4. Select appropriate value for Δt
5. Initialized initial values; $x_o=A$, $v_o=0.0$
6. set $x=x_o$, $v=v_o$, and $t = 0$;
7. calculate the value of force; $F = -kx-bv$
8. calculate the value of acceleration; $a = F/m$
9. calculate velocity; $v = v_o + \Delta v = v_o + a \, \Delta t$
10. calculate position; $x = x_o + \Delta x = x_o + v \, \Delta t$
11. increment value of t by Δt
12. print out values of t and x
13. swap the value of: $x_o=x$, $v_o=v$
14. repeat from step 4 until stopping condition is satisfied ($t<=60.0$)

The java code:

```
public class simplehar01
{
  public static void main(String args[])
  {
   double x, t, delt;
   double k, b, A, m, F, a, v, v0, x0;
   k = 0.2;
   b = 0.1;
   A = 0.1;
  m = 0.5;
  delt = 0.001;
  v0 = 0.0;
  x0 = A;
  x = x0; v = v0;
  t = 0.0;
    while(t<=60.0)
        {
        F = -k*x-b*v;
        a = F/m;
        v = v0 + a*delt;
        x = x0 + v*delt;
        t = t + delt;
        System.out.printf("%f %f\n",t,x);
        x0 = x;
        v0 = v;
        }
  }
}
```

gnuplot result:


b=0.1
b=0.2
b=0.3
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
0
10
20
30
40
50
60
70