

MAT 275 Project 3

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Problem 1. Forced Equations and Resonance

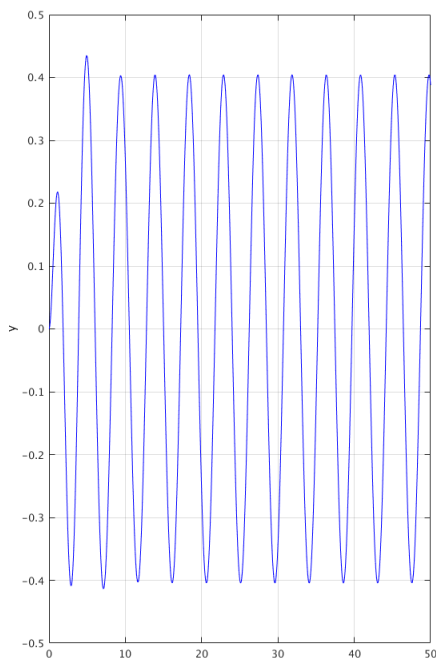
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Problem 1. Forced Equations and Resonance

This homework investigates spring equations using the following code, which has been slightly modified to use correct variable names:

```
function LAB6
omega0 = 2; c = 1; omega = 1.4;
param = [omega0,c,omega];
t0 = 0; y0 = 0; v0 = 0; Y0 = [y0;v0]; tf = 50;
options = odeset('AbsTol',1e-10,'RelTol',1e-10);
[t,Y] = ode45(@f,[t0,tf],Y0,options,param);
y = Y(:,1); v = Y(:,2);
figure(1)
plot(t,y,'b-'); ylabel('y'); grid on;
t1 = 25; i = find(t>t1);
C = (max(Y(i,1))-min(Y(i,1)))/2;
disp(['computed amplitude of forced oscillation = ' num2str(C)]);
Ctheory = 1/sqrt((omega0^2-omega^2)^2+(c*omega)^2);
disp(['theoretical amplitude = ' num2str(Ctheory)]);
function dYdt = f(t,Y,param)
y = Y(1); v = Y(2);
omega0 = param(1); c = param(2); omega = param(3);
dYdt = [ v ; cos(omega*t)-omega0^2*y-c*v ];
```

Originally, this generates the following plot:



Solution**Part (a)**

What is the period of the forced oscillation? What is the numerical value (modulo 2π) of the angle α defined by (L6.4)?

Since the frequency is known ($\omega = \sqrt{\omega_o^2 - \frac{c^2}{4}} = \sqrt{4 - \frac{1}{4}} = \sqrt{3}$), the period is the inverse of this, or $\frac{1}{\sqrt{3}}$ radians, which can be verified on the graph included.

Part (b)

Modify the above code to plot the complementary solution of (L6.1), that is, the first term in (L6.2). First define in the file the angle α using (L6.4), then evaluate the complementary solution y_c by subtracting the quantity $C\cos(\omega t\alpha)$ from the numerical solution y . Plot the resulting quantity. Does it look like an exponentially decreasing oscillation? Why or why not? Include the modified M-file and the corresponding plot.