Example from Braatz, Chapter 1, Example 3

Fiel: `Ch02_Braatz.m`

JCK 12/6/2012

Contents

Problem Statement

Consider a liquid surge vessel with a steady-state volume of 500 liters and steady-state inlet and outlet flow rates of 50 liters/minute. Determine the liquid volume as a function of time if the inlet flow rate is Fin(t) = 50 + 10 sin(0.1t) and the outlet flow rate remains constant at 50 (both flow rates are in units of liters/minute). The liquid is a dilute aqueous solution.

Problem Parameters

The problem does not specify an initial condition, or a time span for simulation which are added here.

```
tspan = [0 600];
Vinitial = 100;
Vmin = 0;
Vmax = 500;
```

Inputs and Outputs

The inputs and outputs are expressed as functions of time.

```
Fin = @(t) 50 + 10*sin(0.1*t);
Fout = @(t) 50;
```

Create the ODE Model

A model consisting of a differential equation is expressed as a function of the independent variable time, and of the state variable Volume.

```
f = @(t,V) Fin(t) - Fout(t);
```

Integration

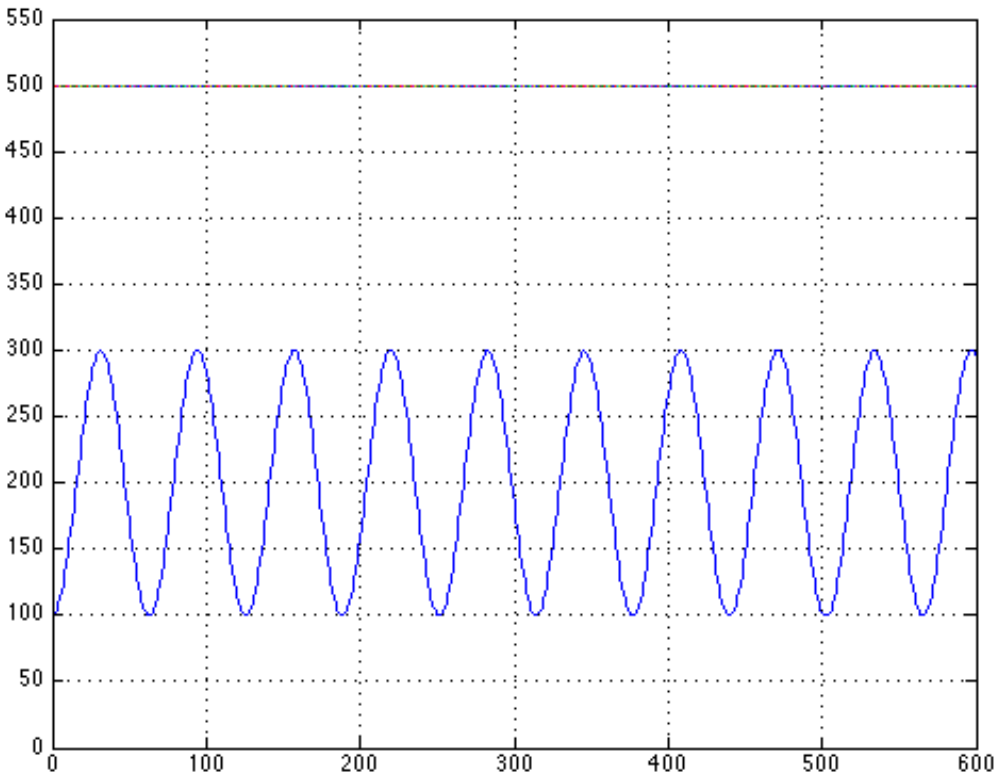
```
Vsoln = ode45(f, tspan, Vinitial);
```

Evaluate the Solution

```
t = min(tspan):max(tspan);
V = deval(Vsoln,t);
```

Plot

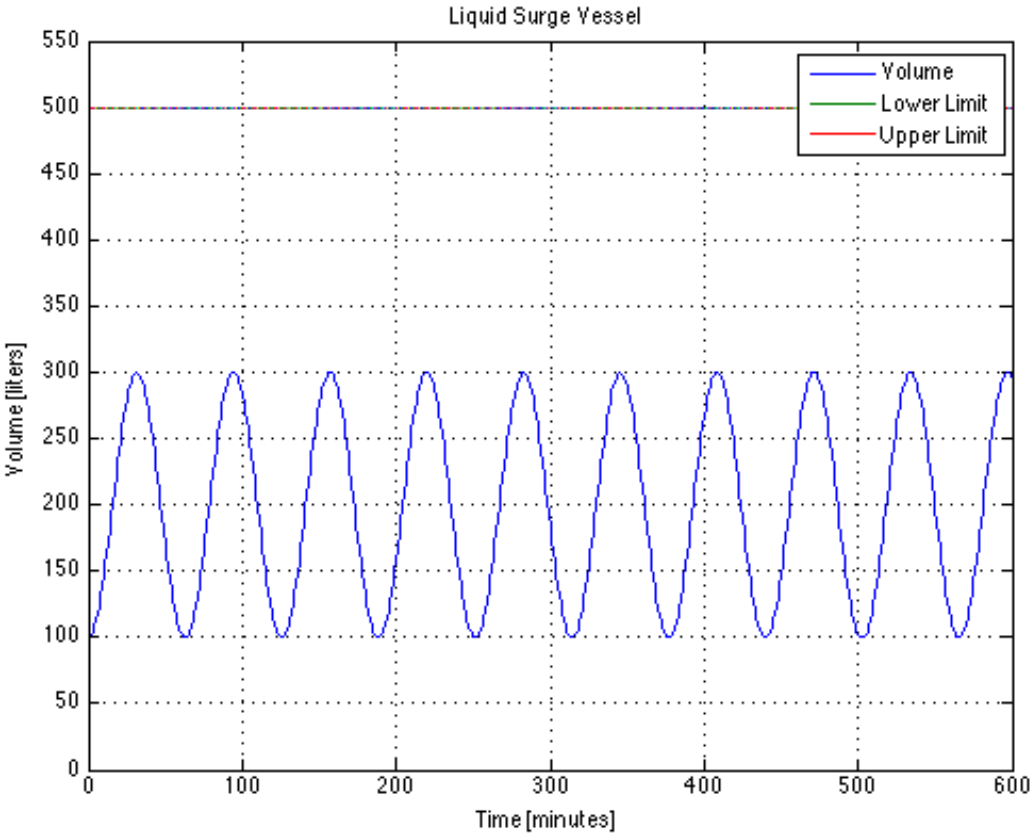
```
plot(t,V,t,Vmin,t,Vmax,'Linewidth',1.5);
axis([min(tspan) max(tspan) 0.9*Vmin 1.1*500]);
grid;
```



Annotate the plot

The following annotaitons are a minimal set that should be part of every plot.

```
title('Liquid Surge Vessel');
xlabel('Time [minutes]');
ylabel('Volume [liters]');
legend('Volume','Lower Limit','Upper Limit');
```



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