Connor McGarty, cmcgarty - HW01: P1.9 from Chapra Text

File: cmcgarty_EE254_HW01_P1_9.m

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Problem, P1.9: A storage tank contains a liquid at depth y where $y = 0$ when the tank is half full. Liquid is withdrawn at a constant flow rate Q to meet demands. The contents are resupplied at a sinusoidal rate $3Q\sin^2(t)$. Equation (1.14) can be written for this system as:

$$\frac{d(Ay)}{dt} = 3Q\sin^2(t)$$

or,

change in volume = inflow - outflow

Or, since the surface area A is constant:

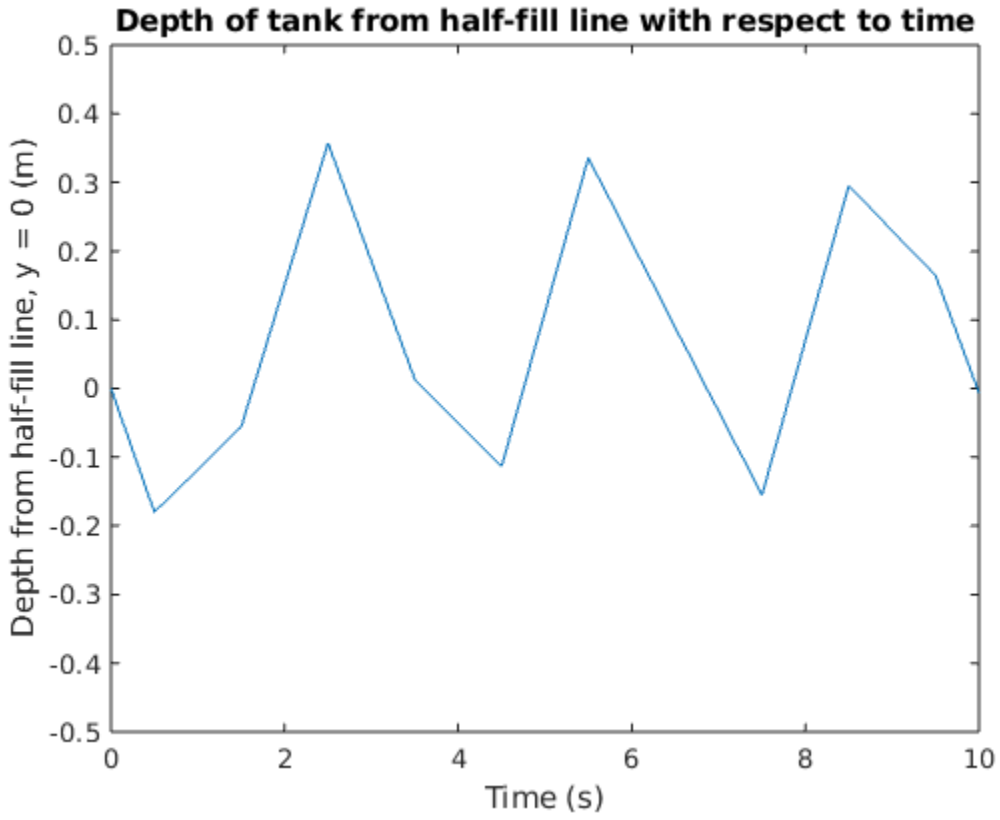
$$\frac{dy}{dt} = 3 * \frac{Q}{A} * \sin^2(t) - \frac{Q}{A}$$

Use Euler's method to solve for the depth y from $t = 0$ to $10s$ with a step size of 0.5 s. The parameter values are $A = 1250m^2$ and $Q = 450\frac{m^3}{s}$. Assume that the initial condition is $y = 0$.

Solution

```
clear;clc;
% Inital conditions
half_full = 0; % m
surface_area = 1250; % m^2, variable A
outflow_rate = 450; % m^3/d, variable Q

% set time conditions
t_start = 0; % s
t_stop = 10; % s
t_current = t_start;
t_previous = t_current;
t_delta = 0.5; % s
t_vector = []; % s
t_vector(1) = t_start;

y_init = 0; % m
y_vector = []; % m
y_vector(1) = y_init;
y_current = y_init;
y_previous = y_current;

iterator = 1;
```

```
done = false; % loop flag

while (done == false)
    iterator = iterator + 1;
    slope = 3 .* (outflow_rate ./ surface_area) .*
 sin(t_previous).^2 ...
                - (outflow_rate ./ surface_area);
    y_current = y_previous + slope * t_delta;
    t_current = t_current + t_delta;
    if t_current >= t_stop
        done = true;
    end
    y_vector(iterator) = y_current;
    t_vector(iterator) = t_current;
    t_previous = t_current;
    t_current = t_current + t_delta;
end

plot(t_vector, y_vector);
axis([0, 10, -.5, .5]);
xlabel('Time (s)');
ylabel('Depth from half-fill line, y = 0 (m)');
title('Depth of tank from half-fill line with respect to time');
```



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