MATLAB Assignment CP10.4

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SELECT DESIGN PARAMETERS

```
desiredPhaseMargins = [53, 60, 65, 70, 75, 80];
% minPo = 1000;
for desiredPhaseMargin = desiredPhaseMargins

    % Requirements
    minDamp = 0.6; % From PO requirement
    minimumPhaseMargin = radtodeg(atan(2.*minDamp./
(-2*minDamp.^2+(1+4.*minDamp.^2).^0.5).^0.5));

    % Setup system
    numerator = (-10)*(-10)*conv([1, 1], [1, 0.01]);
    denominator = conv([1, 10], conv([1, 2, 2], [1, 0.02, 0.0101]));
    G = tf(numerator, denominator);

    if desiredPhaseMargin < minimumPhaseMargin
       % error(sprintf('Selected phase margin %f is too small. Needs
 to be greater than %f', desiredPhaseMargin, minimumPhaseMargin));
    end

    % Calculate alpha and magnitude
    [ Gm , Pm , Wcg , Wcp ] = margin(G);
    requiredAdditionalPhaseMargin = desiredPhaseMargin - Pm;
    alpha = (1 + sin(degtorad(requiredAdditionalPhaseMargin))) / (1 -
 sin(degtorad(requiredAdditionalPhaseMargin)));
    GcMag = 10 * log10(alpha);

    % Find wm such that the uncompenstated system magnitude =
 -10log(alpha)
    desiredMagnitude = -GcMag;
    disp('****************************************');
    disp(sprintf('Find wm such that the uncompenstated system
 magnitude = -10log(alpha) = %f', desiredMagnitude));

    [mag,phase,wout] = bode(G);
    disp(sprintf('Searching for wm in range %f to %f', wout(1),
 wout(end)));
    for i = 1:numel(mag)
        if 20*log10(mag(i)) < desiredMagnitude
            wm = wout(i);
```

```
            thisMag = 20*log10(mag(i));
            thisI = i;
            break;
        end
    end
    disp(sprintf('Found closest wm: %f. Magnitude: %f dB', wm,
 thisMag));
    disp('**************************************');

    wmin = wout(thisI - 1);
    wmax = wout(thisI);
    wList = wmin:0.0001:wmax;
    disp(sprintf('Searching for wm in smaller range %f to %f', wmin,
 wmax));
    [mag,phase,wout] = bode(G, wList);
    for i = 1:numel(mag)
        if 20*log10(mag(i)) < desiredMagnitude
            wm = wout(i);
            thisMag = 20*log10(mag(i));
            thisI = i;
            break;
        end
    end

    disp(sprintf('Found closest wm: %f. Magnitude: %f dB', wm,
 thisMag));
```

```
**************************************
Find wm such that the uncompenstated system magnitude = -10log(alpha)
 = -8.594819
Searching for wm in range 0.000100 to 1000.000000
Found closest wm: 5.570762. Magnitude: -10.887884 dB
**************************************
Searching for wm in smaller range 4.770544 to 5.570762
Found closest wm: 4.951944. Magnitude: -8.595160 dB

**************************************
Find wm such that the uncompenstated system magnitude = -10log(alpha)
 = -10.351416
Searching for wm in range 0.000100 to 1000.000000
Found closest wm: 5.570762. Magnitude: -10.887884 dB
**************************************
Searching for wm in smaller range 4.770544 to 5.570762
Found closest wm: 5.420344. Magnitude: -10.351527 dB

**************************************
Find wm such that the uncompenstated system magnitude = -10log(alpha)
 = -11.814005
Searching for wm in range 0.000100 to 1000.000000
Found closest wm: 6.505211. Magnitude: -13.969260 dB
**************************************
Searching for wm in smaller range 5.570762 to 6.505211
Found closest wm: 5.838962. Magnitude: -11.814337 dB

**************************************
```

```
Find wm such that the uncompenstated system magnitude = -10log(alpha)
 = -13.530634
Searching for wm in range 0.000100 to 1000.000000
Found closest wm: 6.505211. Magnitude: -13.969260 dB
**************************************
Searching for wm in smaller range 5.570762 to 6.505211
Found closest wm: 6.364762. Magnitude: -13.530901 dB

**************************************
Find wm such that the uncompenstated system magnitude = -10log(alpha)
 = -15.628094
Searching for wm in range 0.000100 to 1000.000000
Found closest wm: 7.596405. Magnitude: -17.131889 dB
**************************************
Searching for wm in smaller range 6.505211 to 7.596405
Found closest wm: 7.060211. Magnitude: -15.628163 dB

**************************************
Find wm such that the uncompenstated system magnitude = -10log(alpha)
 = -18.352285
Searching for wm in range 0.000100 to 1000.000000
Found closest wm: 8.870638. Magnitude: -20.386015 dB
**************************************
Searching for wm in smaller range 7.596405 to 8.870638
Found closest wm: 8.055605. Magnitude: -18.352319 dB
```

Formulate Gc

```
z = wm / sqrt(alpha);
p = alpha*z;
Gc = tf([1/z, 1], [1/p, 1]);
L = Gc*G;
```

Show margin

```
fig = figure;
margin(L);
uiwait(fig);
```

Display performance values

```
sys = feedback(L, [1]);
stepInfo = stepinfo(sys);
t = 0:0.01:450;
[y,t]=step(sys, t);
Ess = abs(1-y(end));
disp(sprintf('For desiredPm = %f: T_s: %f. PO: %f. Ess: %f',
 desiredPhaseMargin, stepInfo.SettlingTime, stepInfo.Overshoot, Ess));

%     if stepInfo.Overshoot < minPo
%         disp('----------------FOUND');
%         disp(minPo);
```

```
%         minPo = stepInfo.Overshoot;
%         disp(minPo);
%     end
```

```
For desiredPm = 53.000000: T_s: 1.871389. PO: 37.763471. Ess: 0.167300

For desiredPm = 60.000000: T_s: 192.387657. PO: 56.169954. Ess:
 0.167299

For desiredPm = 65.000000: T_s: 192.432381. PO: 52.513526. Ess:
 0.167299

For desiredPm = 70.000000: T_s: 192.488079. PO: 49.468671. Ess:
 0.167299

For desiredPm = 75.000000: T_s: 192.562762. PO: 47.047665. Ess:
 0.167299

For desiredPm = 80.000000: T_s: 192.674541. PO: 46.012198. Ess:
 0.167299
```

Show step response

```
    fig = figure;
    t = 0:0.01:450;
    step(sys, t);
    uiwait(fig);

end
```

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