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BME501 EXTRA CREDIT PROJECT

DESIGN A LINEAR CIRCUIT (OR DIFFERENTIAL EQUATION) TO IMPLEMENT THE RADIAL ARTERY TO AORTIC TRANSFER FUNCTION, THE INVERSE OF WHAT IS GIVEN BELOW, IN TERMS OF MAGNITUDE AND PHASE RESPONSE (NEGATIVE PHASE=LAG). THE PEAK IN THE MAGNITUDE RESPONSE MEANS THE RADIAL ARTERY MEASUREMENT WILL OVERESTIMATE SYSTOLIC BLOOD PRESSURE RELATIVE TO AORTIC PRESSURE.

SOLUTION

TRANSFER FUNCTION

```
frequency= [1 2 3 4 5 6 7 8 9];
magnitude= [1.1 1.5 2 3 2.3 1.8 1.9 1.7 1.5];
phase= [-0.4 -0.6 -1.2 -2.8 -3.8 -5 -5.6 -6 -7];
t1=0.1125;
t2=0.0398;
plot(frequency, magnitude);
hold on
plot(frequency, phase);
sys = tf([t1 0.5],[t2*t2 t2*0.5 0.5*0.5])
gain= (3/5.6)*sys;
bode(gain,'g',{1,10});
hold off
```

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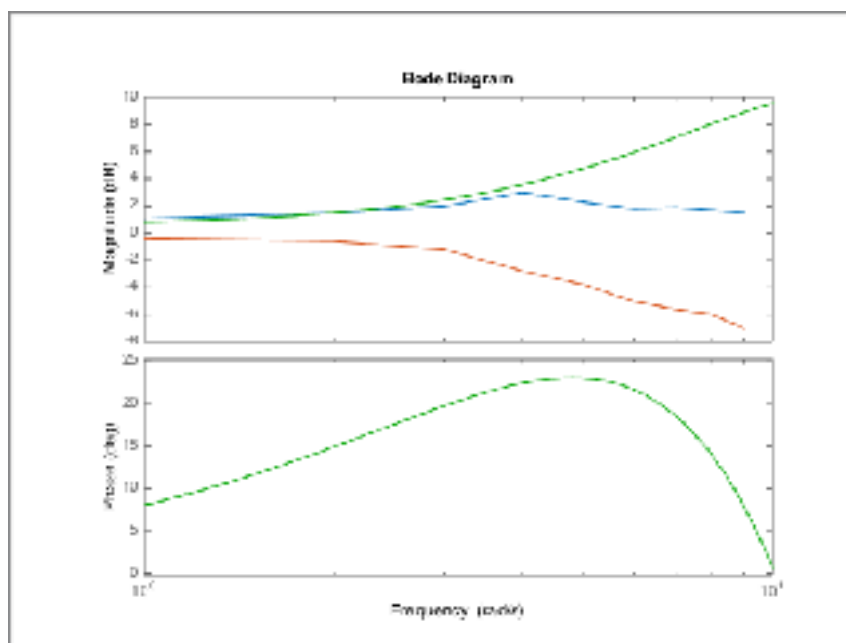
INPUT AND OUTPUT (RADIAL ARTERY) PRESSURES FOR YOUR ESTIMATED TRANSFER FUNCTION.

```
magnitude= [71 104 142 142 124 110 104 91 86 80 73];
t1=0.1125;
t2=0.0398;
sys= tf([t1 0.5],[t2*t2 t2*0.5 0.5*0.5])
gain= (3/5.6)*sys;
t= 0:0.1:1;
y= lsim(gain,magnitude,t);
plot(t,y);
hold on
plot(t, magnitude);
hold off
xlabel('Time(sec)');
ylabel('Pressure(mmhg)');
```


II

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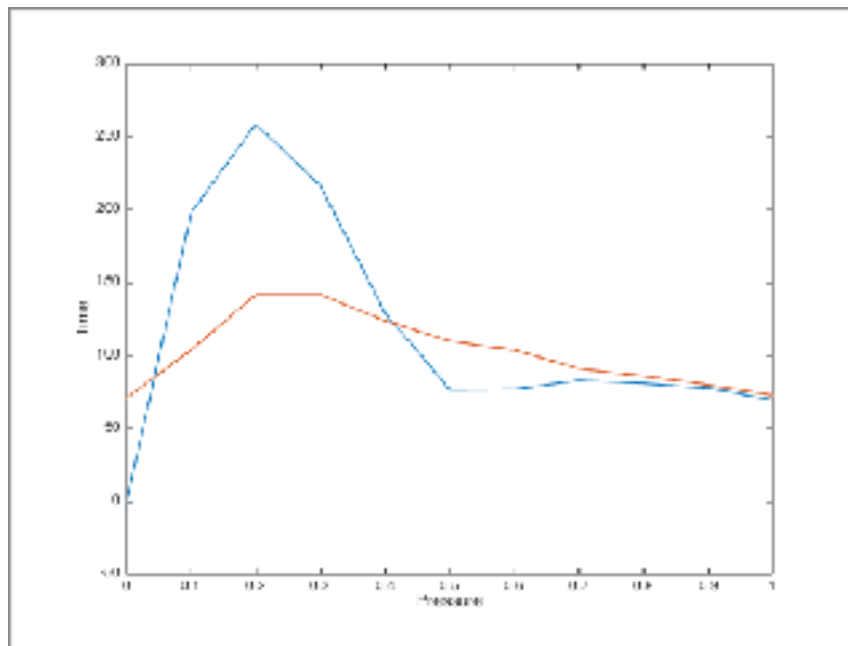
INVERSE OF AORTIC-RADIAL ARTERY TRANSFER FUNCTION

```
t1=0.1125;
t2=0.0398;
sys = tf([t2*t2 t2*0.5 0.5*0.5],[t1 0.5])
bode(sys);
```

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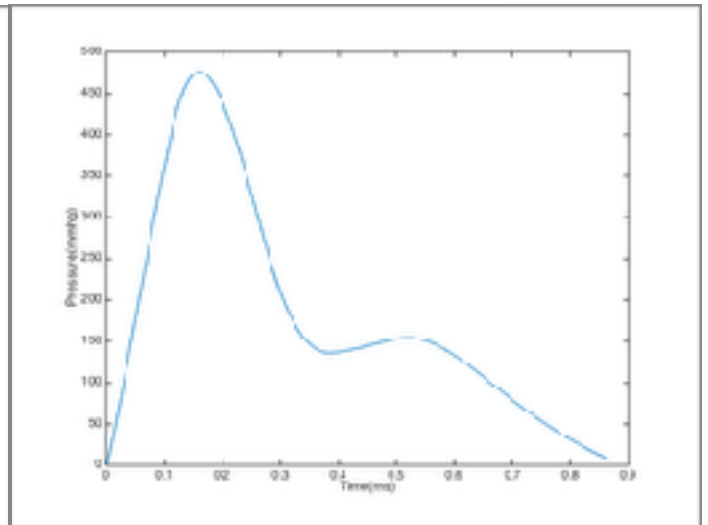vmurali@usc.edu
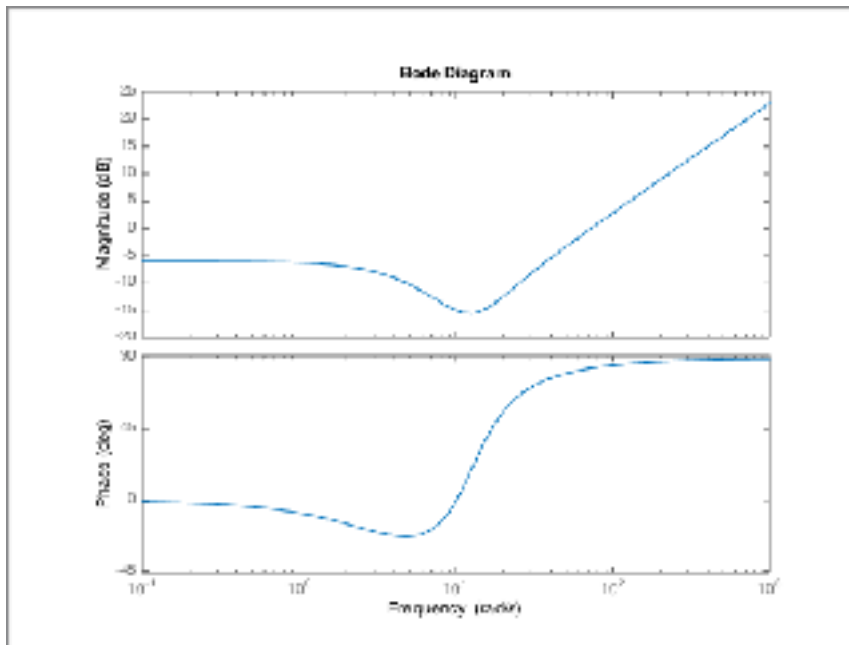
OUTPUT AORTIC PULSE OUTPUT

```
i1=1:1:112;
pa(i1)=45+(125-45)*i1/112;
i2=113:1:274;
pa(i2)=125-(125-90)*(i2-112)/(274-112);
i3=275:1:386;
pa(i3)=90+(100-90)*(i3-274)/(386-275);
i4=387:1:503;
pa(i4)=100-(100-92)*(i4-386)/(503-387);
i5=504:1:872;
pa(i5)=92-(92-30)*(i5-504)/(872-504);
I=1:1:872;
t=.001*I;
t1=0.1125;
t2=0.0398;
sys = tf([t1 0.5],[t2*t2 t2*0.5 0.5*0.5])
y= lsim(sys,pa,t);
plot(t,y);
xlabel('Time(ms)');
ylabel('Pressure(mmhg)');
```

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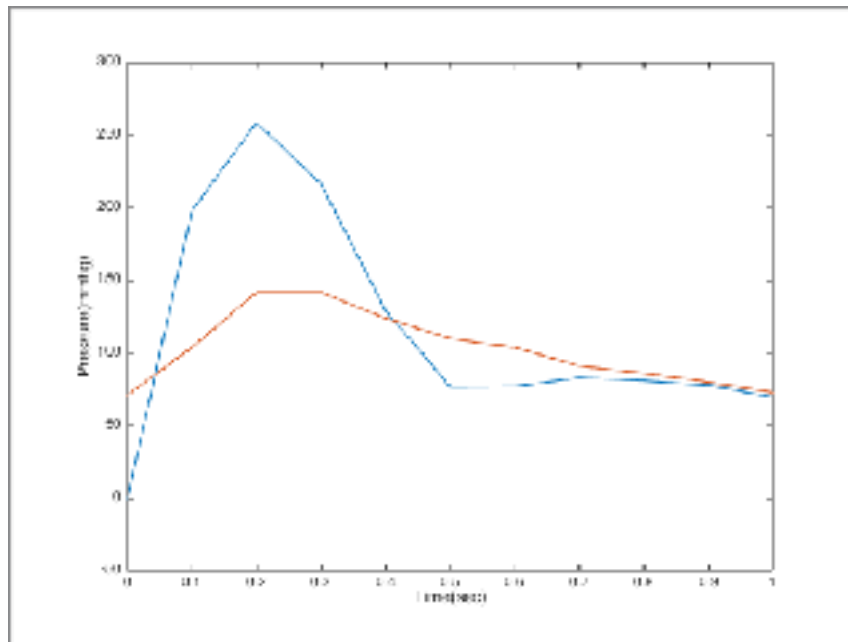
COMPARING AORTIC AND RADIAL PRESSURE CURVES
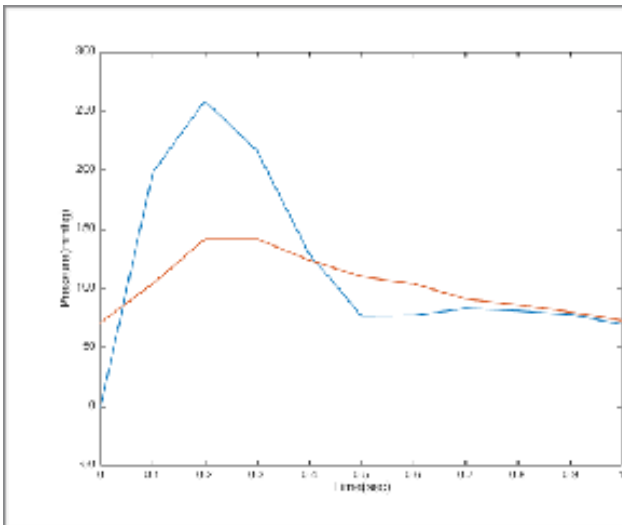
RADIAL ARTERY PRESSURE CURVE   **AORTIC PRESSURE CURVE**

Radial Artery and aortic pressure curves look the same, however their peak values differ. Radial artery pressure peaks to around 255 mmhg whereas the aortic pressure curve peaks to around 475 mmhg.