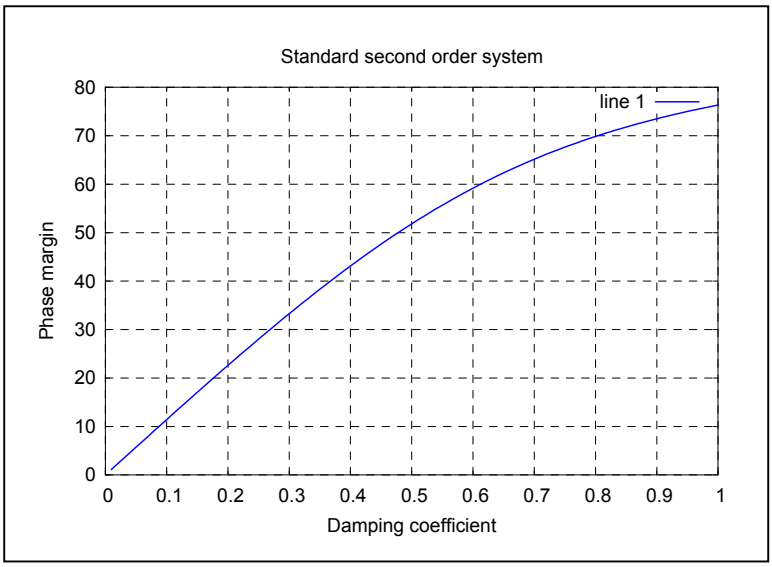
減衰係数ζと２次系の過渡特性諸量の関係



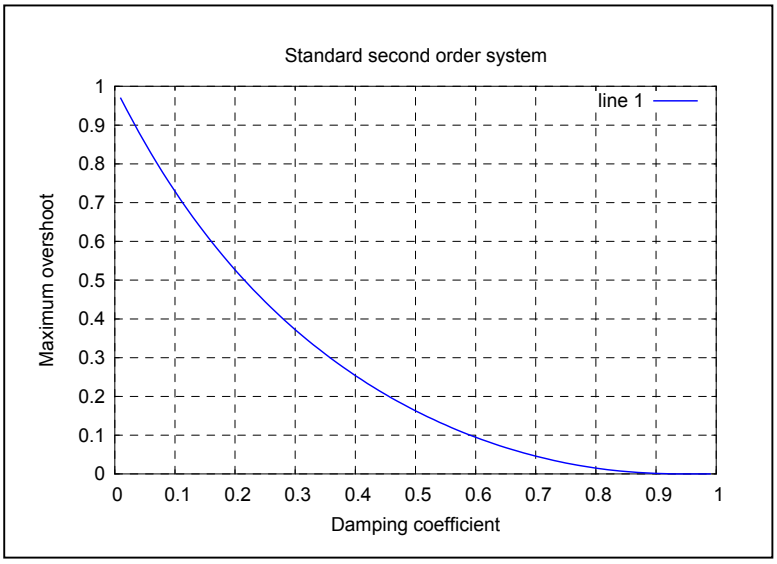
減衰係数ζと位相余裕θ_m

位相余裕

$$\theta_m = 90^\circ - \tan^{-1}\frac{nu}{2\zeta}$$

$$nu = \sqrt{\sqrt{4\zeta^4+1}-2\zeta^2}$$

```
clear;
for i=1:100,
zt=i*0.01;
zet(i)=zt;
in1=sqrt(4*zt^4+1)-2*zt^2;
in2=sqrt(in1)/(2*zt);
thetam(i)=90-atan(in2)*180/pi;
end;
grid("on")
title('Standard second order system')
xlabel('Damping coefficient')
ylabel('Phase margin')
plot(zet,thetam,'-')
```

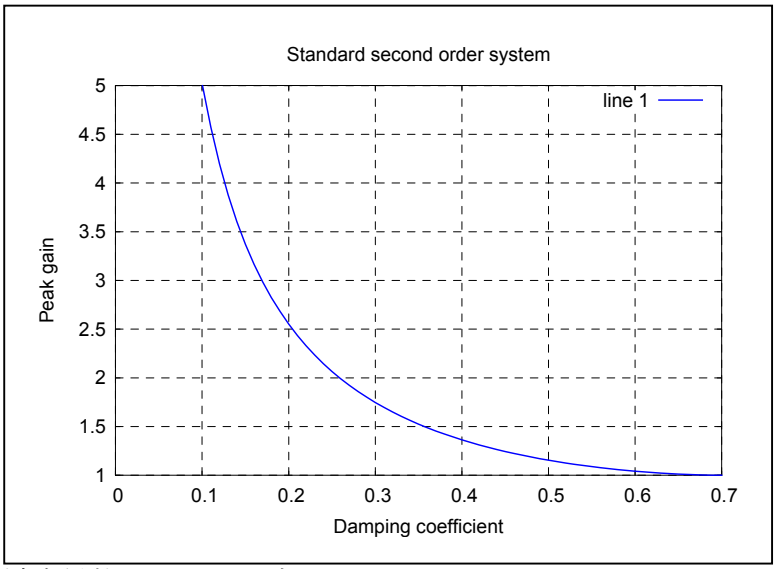


減衰係数ζと最大行過ぎC_m

最大行過ぎ量

$$C_m = \exp\left(-\frac{\zeta\pi}{\sqrt{1-\zeta^2}}\right)$$

```
clear
for i=1:99,
zt=i*0.01;
zet(i)=zt;
in1=sqrt(1-zt^2);
cm(i)=exp(-zt*pi/in1);
end;
grid("on")
title('Standard second order system')
xlabel('Damping coefficient')
ylabel('Maximum overshoot')
plot(zet,cm,'-')
```



減衰係数ζとピークゲインM_p

ピークゲイン

$$M_p = \frac{1}{2\zeta\sqrt{1-\zeta^2}}, \quad \zeta \le 0.707$$

```
clear
for i=1:70,
zt=i*0.01;
zet(i)=zt;
in1=sqrt(1-zt^2);
mp(i)=1/(2*zt*in1);
end;
grid("on")
axis([0,0.7,1.0,5.0]);
title('Standard second order system')
xlabel('Damping coefficient')
ylabel('Peak gain')
plot(zet,mp,'-')
```