QEA Night 10

Exercise

In[1]:=

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eq1 = θ[s] == e_rr2[s] G_P[s] G_MC[s] G_VC[s];
eq2 = V_d[s] == e_rr1[s] G_PI[s];
eq3 = e_rr1[s] == θ_d[s] - θ[s] + G_DC[s] V[s];
eq4 = V[s] == e_rr2[s] G_P[s] G_MC[s];
eq5 = e_rr2[s] == V_d[s] - V[s];
sol = Solve[{eq1, eq2, eq3, eq4, eq5}, {θ[s], V_d[s], e_rr1[s], V[s], e_rr2[s]}][[1]];
{G_TOTALSYSTEM[s] → θ[s] / θ_d[s] /. sol} (* this is a rule to replace G_TOTALSYSTEM,
you can just extract the value by using the righthand side of the rule *)
trans = θ[s] / θ_d[s] /. sol /. {G_PI[s] → K_p + (K_i / s), G_VC[s] → -s / (L s^2 - g),
   G_MC[s] → (a b) / (s + a), G_P[s] → J_p + (J_i / s), G_DC[s] → K_t / s}
tsumsub = Factor[trans /. {b → 1 / 400, a → 14 , L → .1, g → 9.8}]
```

Out[7]=
$$\left\{G_{TOTALSYSTEM}[s] \to \frac{G_{MC}[s]\, G_P[s]\, G_{PI}[s]\, G_{VC}[s]}{1 + G_{MC}[s]\, G_P[s] - G_{DC}[s]\, G_{MC}[s]\, G_P[s]\, G_{PI}[s] + G_{MC}[s]\, G_P[s]\, G_{PI}[s]\, G_{VC}[s]}\right\}$$

Out[8]=
$$-\frac{a\, b\, s \left(\frac{J_i}{s} + J_p\right) \left(\frac{K_i}{s} + K_p\right)}{(a+s)\left(-g + L\, s^2\right)\left(1 + \frac{a\, b \left(\frac{J_i}{s}+J_p\right)}{a+s} - \frac{a\, b\, s \left(\frac{J_i}{s}+J_p\right)\left(\frac{K_i}{s}+K_p\right)}{(a+s)\left(-g+L\, s^2\right)} - \frac{a\, b \left(\frac{J_i}{s}+J_p\right)\left(\frac{K_i}{s}+K_p\right) K_t}{s\,(a+s)}\right)}$$

Out[9]=
$$-\left(\left(0.35\, s^2 \left(1.\, J_i\, K_i + 1.\, s\, J_p\, K_i + 1.\, s\, J_i\, K_p + 1.\, s^2\, J_p\, K_p\right)\right) \Big/ \left(-1372.\, s^3 - 98.\, s^4 + 14.\, s^5 + 1.\, s^6 - 3.43\, s^2\, J_i + 0.035\, s^4\, J_i - 3.43\, s^3\, J_p + 0.035\, s^5\, J_p - 0.35\, s^2\, J_i\, K_i - 0.35\, s^3\, J_p\, K_i - 0.35\, s^3\, J_i\, K_p - 0.35\, s^4\, J_p\, K_p + 3.43\, J_i\, K_i\, K_t - 0.035\, s^2\, J_i\, K_i\, K_t + 3.43\, s\, J_p\, K_i\, K_t - 0.035\, s^3\, J_p\, K_i\, K_t + 3.43\, s\, J_i\, K_p\, K_t - 0.035\, s^3\, J_i\, K_p\, K_t + 3.43\, s^2\, J_p\, K_p\, K_t - 0.035\, s^4\, J_p\, K_p\, K_t\right)\right)$$

Out[•]=
$$-\left(\left(0.249\, s^2 \left(1.\, J_i\, K_i + 1.\, s\, J_p\, K_i + 1.\, s\, J_i\, K_p + 1.\, s^2\, J_p\, K_p\right)\right) \Big/ \left(-813.4\, s^3 - 98.\, s^4 + 8.3\, s^5 + 1.\, s^6 - 2.4402\, s^2\, J_i + 0.0249\, s^4\, J_i - 2.4402\, s^3\, J_p + 0.0249\, s^5\, J_p - 0.249\, s^2\, J_i\, K_i - 0.249\, s^3\, J_p\, K_i - 0.249\, s^3\, J_i\, K_p - 0.249\, s^4\, J_p\, K_p + 2.4402\, J_i\, K_i\, K_t - 0.0249\, s^2\, J_i\, K_i\, K_t + 2.4402\, s\, J_p\, K_i\, K_t - 0.0249\, s^3\, J_p\, K_i\, K_t + 2.4402\, s\, J_i\, K_p\, K_t - 0.0249\, s^3\, J_i\, K_p\, K_t + 2.4402\, s^2\, J_p\, K_p\, K_t - 0.0249\, s^4\, J_p\, K_p\, K_t\right)\right)$$

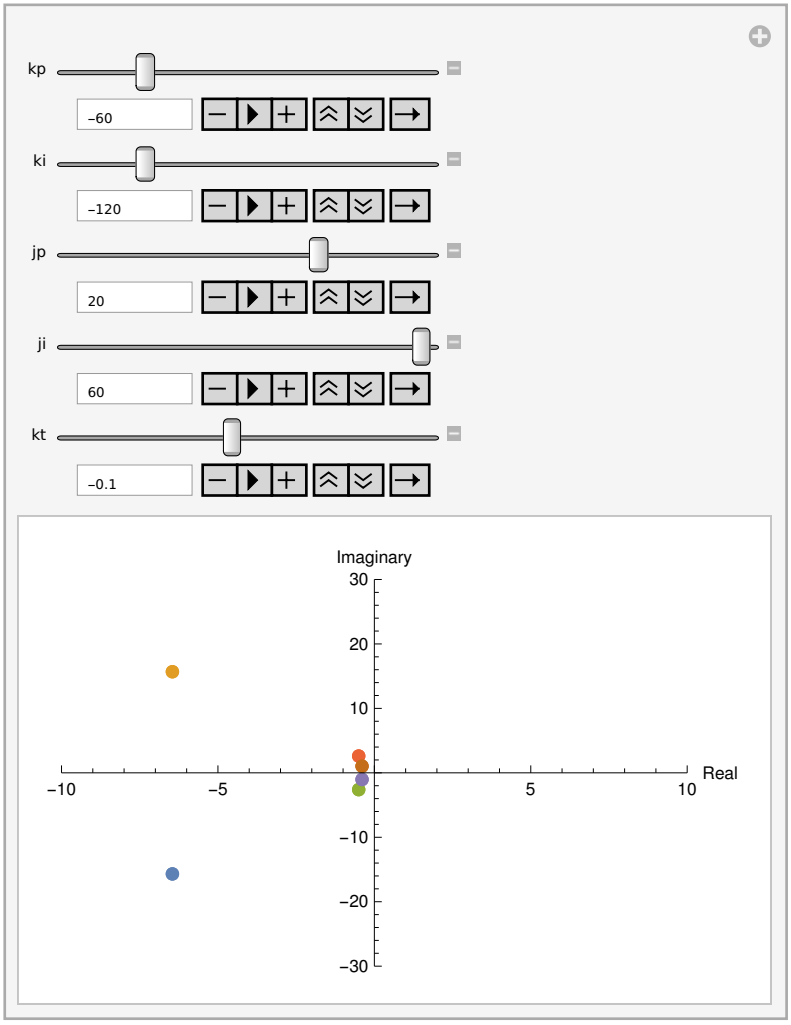
In[ ]:=
```
poles = ReIm[Values[Solve[Denominator[tsumsub] == 0, s]]];
ListPlot[poles /. {Kp → -88, Ki → -100, Jp → 10, Ji → 56, Kt → -0.1}];
```

... Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

In[10]:=
```
(*Sweep values of kp and ki*)
f[Kp_, Ki_, Jp_, Ji_, Kt_] = ReIm[N[Values[Solve[
      Denominator[tsumsub /. {Kp → Kp, Ki → Ki, Jp → Jp, Ji → Ji, Kt → Kt}] == 0, s]]]];
(*returns list as s→[[values]]*)
Manipulate[
 ListPlot[f[Kp, Ki, Jp, Ji, Kt] /. {Kp → kp, Ki → ki, Jp → jp, Ji → ji, Kt → kt},
  AxesLabel → {"Real", "Imaginary"}, PlotStyle → PointSize[Large],
  PlotRange → {{-10, 10}, {-30, 30}}], {kp, -100, 100},
 {ki, -200, 200}, {jp, -50, 50}, {ji, -60, 60}, {kt, -1, 1}]
```

... Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[11]=



In[•]:=
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ClearAll["Global`*"]
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