QEA Rocky Final

Equations == Equations

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(*Below we setup our system of equations and
 solved for the transfer function of the entire system.*)
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$eq1 = \theta[s] == e_{rr2}[s]\ G_P[s]\ G_{MC}[s]\ G_{VC}[s];$

$eq2 = V_d[s] == e_{rr1}[s]\ G_{PI}[s];$

$eq3 = e_{rr1}[s] == \theta_d[s] - \theta[s] + G_{DC}[s]\ V[s];$

$eq4 = V[s] == e_{rr2}[s]\ G_P[s]\ G_{MC}[s];$

$eq5 = e_{rr2}[s] == V_d[s] - V[s];$

$sol = Solve[\{eq1, eq2, eq3, eq4, eq5\}, \{\theta[s], V_d[s], e_{rr1}[s], V[s], e_{rr2}[s]\}][[1]];$

$\left\{G_{TOTALSYSTEM}[s] \to \frac{\theta[s]}{\theta_d[s]} /. sol\right\}$ (* this is a rule to replace $G_{TOTALSYSTEM}$, you can just extract the value by using the righthand side of the rule *)

$trans = \frac{\theta[s]}{\theta_d[s]} /. sol /. \{G_{PI}[s] \to K_p + (K_i / s), G_{VC}[s] \to -s / (L s^2 - g), G_{MC}[s] \to (a b) / (s + a), G_P[s] \to J_p + (J_i / s), G_{DC}[s] \to K_t / s\}$

$tsumsub = Factor[trans /. \{b \to 1/400, a \to 14, L \to .1, g \to 9.8\}];$
(*Substitute for known values*)

Out[19]= $\{G_{TOTALSYSTEM}[s] \to (G_{MC}[s]\ G_P[s]\ G_{PI}[s]\ G_{VC}[s]) / (1 + G_{MC}[s]\ G_P[s] - G_{DC}[s]\ G_{MC}[s]\ G_P[s]\ G_{PI}[s] + G_{MC}[s]\ G_P[s]\ G_{PI}[s]\ G_{VC}[s])\}$

Out[20]= $$-\left(\left(a\,b\,s\left(\frac{J_i}{s}+J_p\right)\left(\frac{K_i}{s}+K_p\right)\right)\Big/\left((a+s)\left(-g+L\,s^2\right)\left(1+\frac{a\,b\left(\frac{J_i}{s}+J_p\right)}{a+s}-\frac{a\,b\,s\left(\frac{J_i}{s}+J_p\right)\left(\frac{K_i}{s}+K_p\right)}{(a+s)\left(-g+L\,s^2\right)}-\left(a\,b\left(\frac{J_i}{s}+J_p\right)\left(\frac{K_i}{s}+K_p\right)K_t\right)\Big/(s\,(a+s))\right)\right)\right)$$

Functions[pars]

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(*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]]*)
poles = ReIm[Values[Solve[Denominator[tsumsub] == 0, s]]];
(*returns poles of the denominator*)
ListPlot[f[Kp, Ki, Jp, Ji, Kt] /. {Kp → -60, Ki → -55, Jp → 14, Ji → 90, Kt → -0.1},
 AxesLabel → {"Real", "Imaginary"}, PlotStyle → PointSize[Large],
 PlotRange → {{-10, 0}, {-30, 30}}, LabelingFunction → (Callout[#1, Automatic] &)]
 (*plots one set of points-in this case the ones we used*)
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In[26]:=
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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}}, LabelingFunction → (Callout[#1, Automatic] &),
  PlotLabel → "Poles of the Transfer Function"], {kp, -100, 100},
 {ki, -200, 200}, {jp, -50, 50}, {ji, -60, 60}, {kt, -1, 1}]
```

Out[26]=