Root locus preparation of equations for plots generation

Relevant information:

Using the characteristic equation (CE) for a non-ideal single-ended common-drain Colpitts oscillator, appropriate expression is derived in order to be able to simulate the relevant root locus plots.

Using this expression, the root locus plots are generated in the "RLocus.m" matlab script.

Relevant variables:

L - LC resonant circuit inductance

R - Total circuit resistance

g_m - Transistor transconductance

C_1/C_2 - LC resonant circuit capacitances

R_p - LC inductor equivalent series parasitic resistance

C_p - LC inductor equivalent parallel parasitic capacitance

1. Characteristic equation for Rp and Cp

$$LR(C_1C_2+C_1C_p+C_2C_p)s^3+\left[L(C_1+C_p)+RR_p[C_p(C_1+C_2)+C_1C_2]+g_mLRC_p\right]s^2+$$
$$+\left[R(C_1+C_2)+R_p(C_1+C_p)+g_mRR_pC_p\right]s+\ g_mR+1=0$$

Extracting g_m*R from relevant terms and refactoring gives:

$$LR(C_1C_2+C_1C_p+C_2C_p)s^3+\left[L(C_1+C_p)+RR_p[C_p(C_1+C_2)+C_1C_2]\right]s^2+$$
$$+\left[R(C_1+C_2)+R_p(C_1+C_p)\right]s+1+g_mR\left[LC_ps^2+R_pC_ps+1\right]=0$$

Dividing above equation from both sides with the following term:

$$LR(C_1C_2+C_1C_p+C_2C_p)s^3+\left[L(C_1+C_p)+RR_p[C_p(C_1+C_2)+C_1C_2]\right]s^2+$$
$$+\left[R(C_1+C_2)+R_p(C_1+C_p)\right]s$$

gives:

$$1+g_mR\frac{LC_ps^2+R_pC_ps+1}{LR(C_1C_2+C_1C_p+C_2C_p)s^3+\left[L(C_1+C_p)+RR_p[C_p(C_1+C_2)+C_1C_2]\right]s^2+\left[R(C_1+C_2)+R_p(C_1+C_p)\right]s+1}=0$$