Chapter 14: Control theory: graphical techniques

ML_14_1 Root locus

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% Onwubolu, G. C.
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%
% Chapter 14: Control theory: graphical techniques: Root Locus Techniques
%
% Example 14.1: MATLAB allows root loci to be plotted with the
% rlocus(GH) command, where G(s)H(s) = numgh/dengh and GH is an LTI
transfer-
% function object. Points on the root locus can be selected interactively
% using the [K,p] = rlocfind(GH) command. MATLAB then yields the gain(K)
at
% that point as well as all other poles(p) that have that gain. We can zoom
% in and out of the root locus by changing the range of axis values using
% the command axis([xmin,xmax,ymin,ymax]). The root locus can be drawn
% over a grid that shows constant damping ratio(z) and constant natural
% frequency(wn) curves using the sgrid(z,wn) command. To plot multiple
% z and wn curves, use z = zmin:zstep:zmax and wn = wnmin:wnstep:wnmax
to
% specify a range of values.

'Example 14.1'              % Display label.
clf                         % Clear graph on screen.
%numgh=[1 -4 20];                 % Define numerator of G(s)H(s).
%dengh=poly([-2 -4]);             % Define denominator of G(s)H(s).
%numgh=[1 1.5];                  % Define numerator of G(s)H(s).
%dengh=poly([0 -1 -10]);               % Define denominator of G(s)H(s).
numgh=[1 4];                 % Define numerator of G(s)H(s).
dengh=[0 -1 -2 -6];             % Define denominator of G(s)H(s).
'G(s)H(s)'                   % Display label.
GH=tf(numgh,dengh)                % Create G(s)H(s) and display.
rlocus(GH)                    % Draw root locus.
z=0.2:0.05:0.5;                % Define damping ratio values: 0.2 to
                            % 0.5in steps of 0.05.
wn=0:1:10;                      % Define natural frequency values: 0
                            % to 10 in steps of 1.
sgrid(z,wn)                    % Generate damping ratio and natural
                            % frequency grid lines for root
                            % locus.
title('Root Locus')             % Define title for root locus.
pause
rlocus(GH)                    % Draw close-up root locus.
axis([-3 1 -4 4])             % Define range on axes for root locus
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                        % close-up view.
title('Close-up')         % Define title for close-up root
                        % locus.
%z=0.45;                  % Define damping ratio line for
z=0.8;                  % Define damping ratio line for
                        % overlay on close-up root locus.
wn=0;                    % Suppress natural frequency overlay
                        % curves.
sgrid(z,wn)               % Overlay damping ratio curve on
                        % close-up root locus.
for k=1:3                % Loop allows 3 points to be selected
                        % as per Example 8.7
                        % (z=0.45, jw crossing, breakaway).
[K,p]=rlocfind(GH)            % Generate gain, K, and closed-loop
                        % poles, p,
                        % for point selected interactively on
                        % the root locus.
end                     % End loop.
pause
```