ML_13_2_2 to calculate the values in a Routh table that contains a variable gain, K

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%
% Chapter 13: Stability via Routh table
%
% Example 13.8    MATLAB's Symbolic Math Toolbox may
% be used conveniently to calculate  the values in a Routh table
% that contains a variable gain, K. The technique is similar to the
% previous example, ch6sp1, except that K, rather than e, is used as the
% symbolic object. We now demonstrate the solution of Example 13.8 in the
% text using MATLAB and MATLAB's Symbolic Math Toolbox.

'Example 13.8'       % Display label.
% -det([si() si();sj() sj()])/sj()
                     % Template for use in each cell.
syms K                    % Construct a symbolic object for
                     % gain, K.
s3=[1   50   0   0];         % Create s^3 row of Routh table.
s2=[15   K   0   0];         % Create s^2 row of Routh table.
s1=[-det([s3(1) s3(2);s2(1) s2(2)])/s2(1)...
 -det([s3(1) s3(3);s2(1) s2(3)])/s2(1)   0   0];
                     % Create s^1 row of Routh table.
s0=[-det([s2(1) s2(2);s1(1) s1(2)])/s1(1)...
 -det([s2(1) s2(3);s1(1) s1(3)])/s1(1)   0   0];
                     % Create s^0 row of Routh table.
's3'                  % Display label.
s3=sym(s3);                % Convert s3 to a symbolic object.
s3=simplify(s3);           % Simplify terms in s^3 row.
pretty(s3)                % Pretty print s^3 row.
's2'                  % Display label.
s2=sym(s2);                % Convert s2 to a symbolic object.
s2=simplify(s2);           % Simplify terms in s^2 row.
pretty(s2)                % Pretty print s^2 row.
's1'                  % Display label.
s1=sym(s1);                % Convert s1 to a symbolic object.
s1=simplify(s1);           % Simplify terms in s^1 row.
pretty(s1)                % Pretty print s^1 row.
's0'                  % Display label.
s0=sym(s0);                % Convert s0 to a symbolic object.
s0=simplify(s0);           % Simplify terms in s^0 row.
pretty(s0)                % Pretty print s^0 row.
```