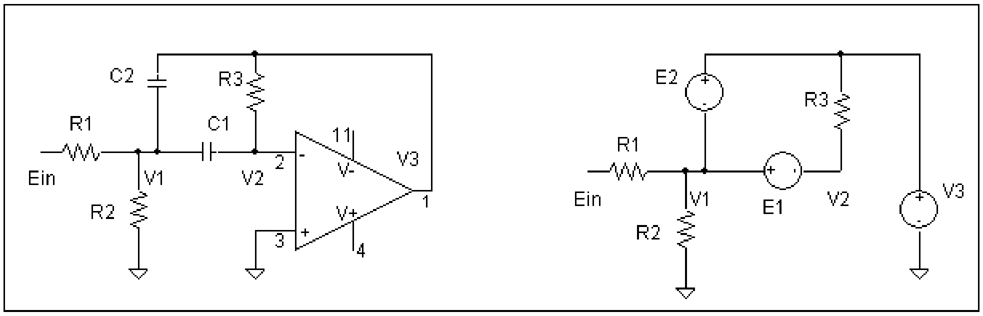
11/15/2006

Improved Multiple Feedback Bandpass Filter Monte Carlo Analysis (MCA) – DS Method

Bandpass Filter Converted Circuit



Due to the inverting opamp, V2 = 0. At first glance there are only two unknown nodes, V1 and V3. In the converted circuit, V1 = E1 – V2 = E1 – 0 = 1V, and V3 is the only unknown node. Then U = 1, and, since there are two capacitors, N = 2, U + N = 3 dc equations are required.

At node V1 = E1;

$$\frac{\mathrm{Ein}-\mathrm{E1}}{\mathrm{R1}}=\frac{\mathrm{E1}}{\mathrm{R2}}+i_{C1}+i_{C2}, \quad \text{or} \quad i_{C1}+i_{C2}=-\mathrm{E1}\left(\frac{1}{\mathrm{R1}}+\frac{1}{\mathrm{R2}}\right)+\frac{\mathrm{Ein}}{\mathrm{R1}}$$

At node V3 = 0

$$i_{C1}=\frac{\mathrm{V2}-\mathrm{V3}}{\mathrm{R3}}=\frac{-\mathrm{V3}}{\mathrm{R3}}, \quad \text{or} \quad i_{C1}+\frac{\mathrm{V3}}{\mathrm{R3}}=0$$

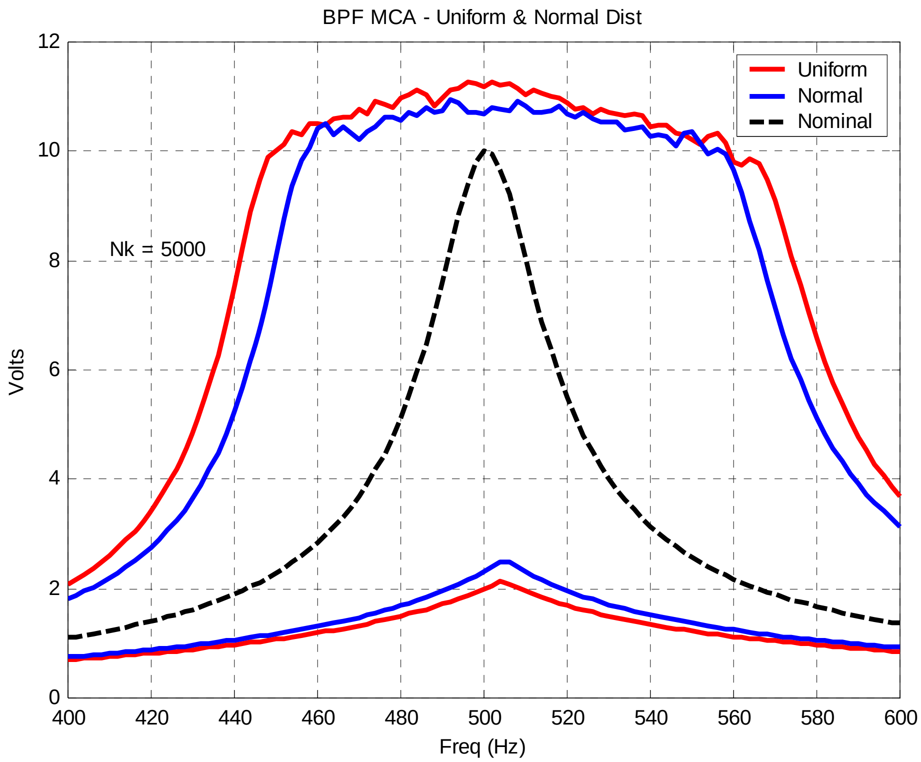
The last equation is obtained from

$$\mathrm{E2}=\mathrm{V1}-\mathrm{V3}=\mathrm{E1}-\mathrm{V3}, \quad \text{or} \quad \mathrm{V3}=\mathrm{E1}-\mathrm{E2}$$

A1 and B2 are easily constructed from the three equations.

$$\begin{array}{ccccc} & \mathrm{V3} & \mathrm{iC1} & \mathrm{iC2} & \\ \mathrm{A1}= & \multicolumn{3}{c}{\begin{bmatrix} 0 & 1 & 1 \\ \frac{1}{\mathrm{R3}} & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}} & \end{array} \qquad \begin{array}{cccc} & \mathrm{E1} & \mathrm{E2} & \mathrm{Ein} \\ \mathrm{B2}= & \multicolumn{3}{c}{\begin{bmatrix} -\left(\frac{1}{\mathrm{R1}}+\frac{1}{\mathrm{R2}}\right) & 0 & \frac{1}{\mathrm{R1}} \\ 0 & 0 & 0 \\ 1 & -1 & 0 \end{bmatrix}} \end{array} \quad \text{Column labels}$$

See M-File mfpbmca.m.


BPF MCA - Uniform & Normal Dist
Uniform
Normal
Nominal
Nk = 5000
Volts
Freq (Hz)
0
2
4
6
8
10
12
400
420
440
460
480
500
520
540
560
580
600