

ECE615 Mixed-Signal IC Design

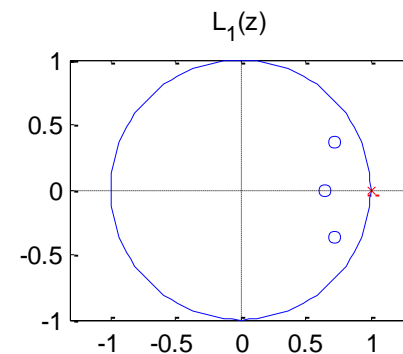
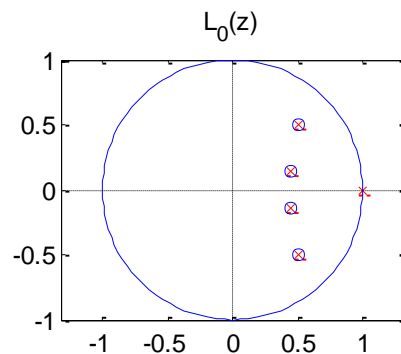
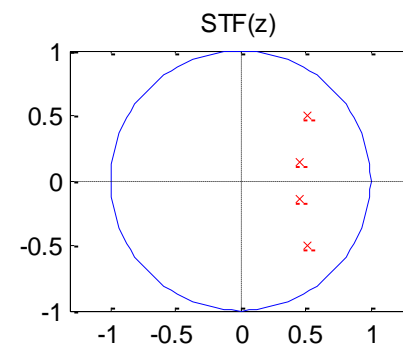
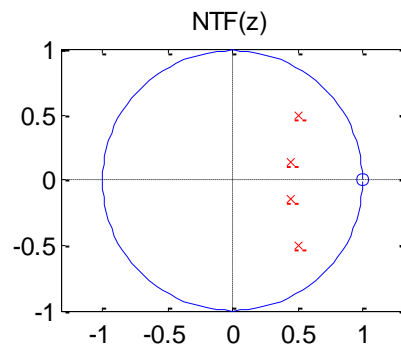
Lecture 19 Slides

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Mixed Signal IC Laboratory
Boise State University

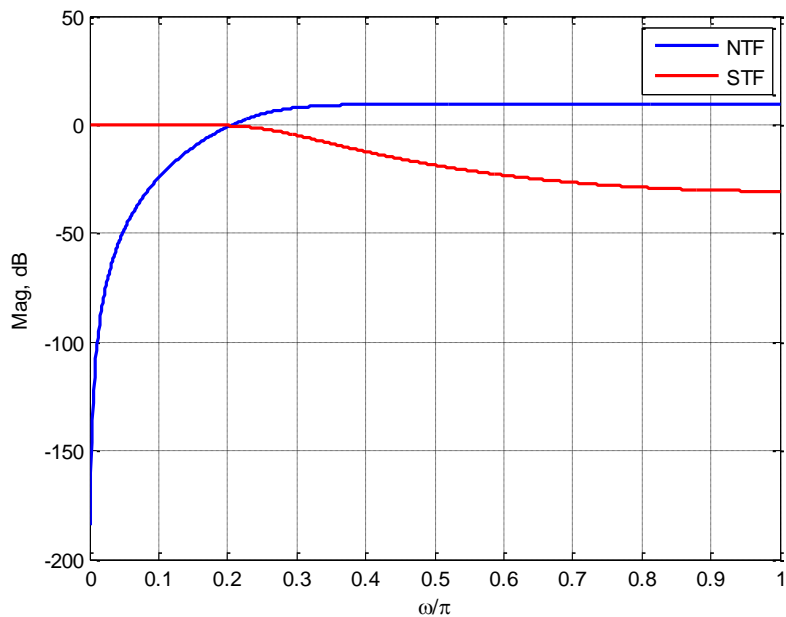
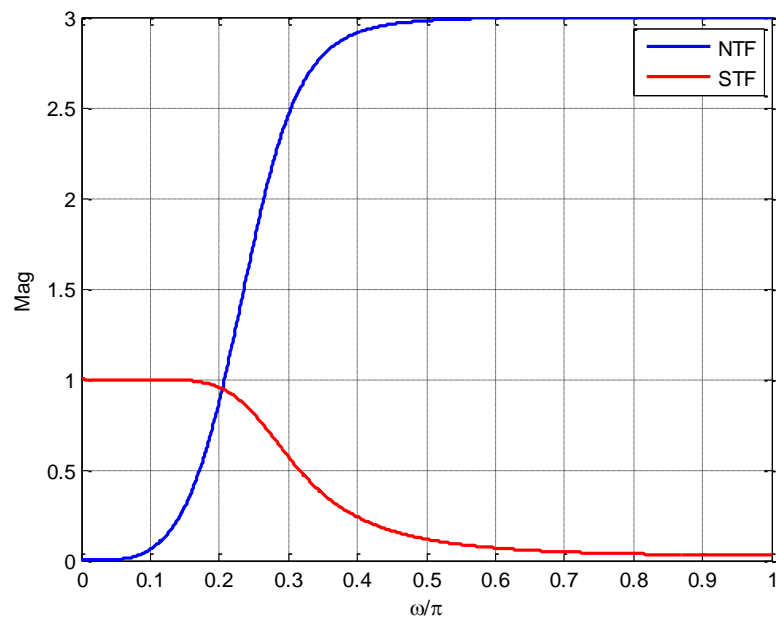
CIFB Example 1

- ❑ CIFB, order = 4
- ❑ All NTF zeros at $z=1$, i.e. $\text{opt} = 0$.
- ❑ OBG = 3, OSR = 16, $n\text{Lev} = 15$.
- ❑ Only single input coupling is used
 - $b(2:\text{end}) = 0$
 - Maxflat poles in STF
- ❑ $\mathbf{a} = [0.16 \ 0.86 \ 1.9 \ 2.1]$
- ❑ $\mathbf{b} = [0.16 \ 0 \ 0 \ 0]$
- ❑ $\mathbf{c} = [1 \ 1 \ 1 \ 1]$
- ❑ $\mathbf{g} = [0 \ 0]$



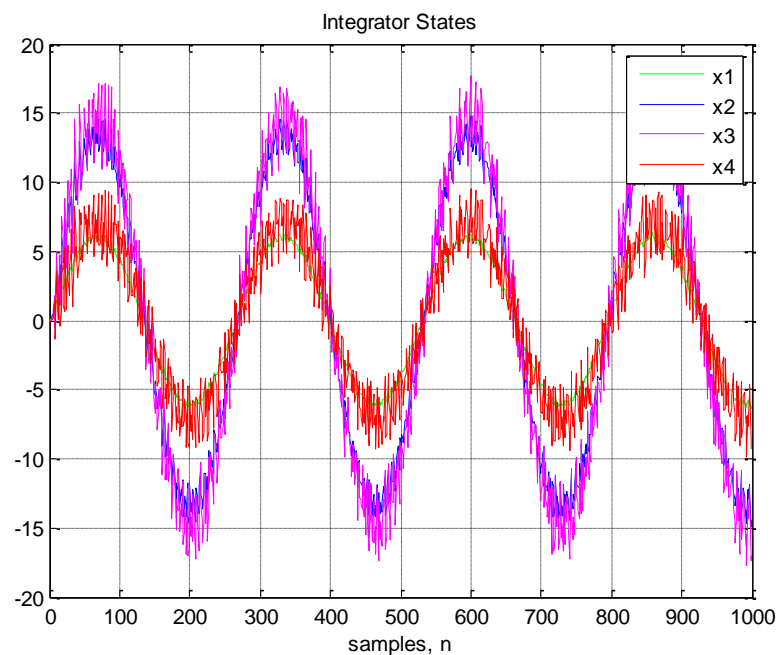
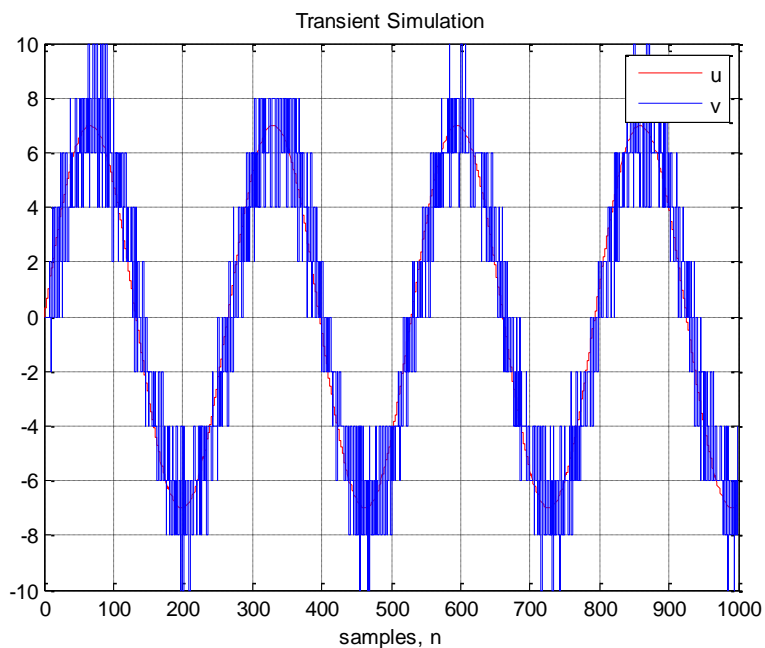
File: CIFB_4th_Order_1.m

CIFB Example 1 contd. : NTF and STF



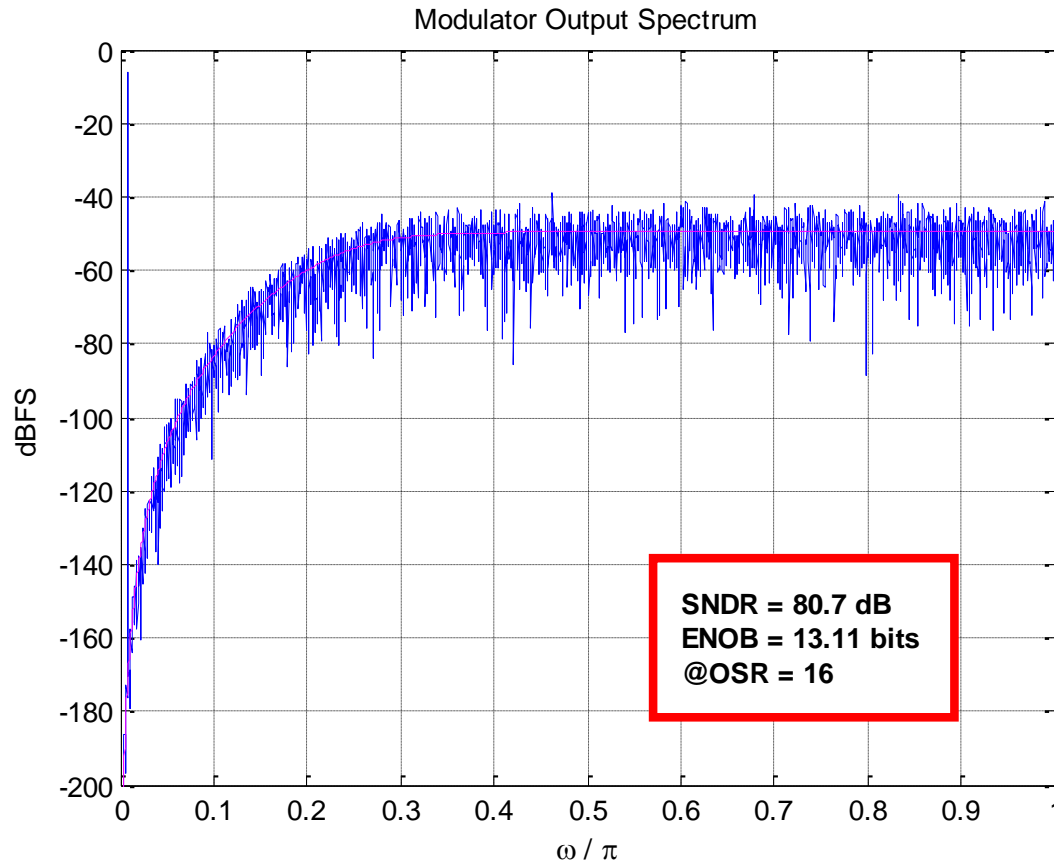
File: CIFB_4th_Order_1.m

CIFB Example 1 contd. : Loop-Filter States



File: CIFB_4th_Order_1.m

CIFB Example 1 contd. : Simulated Spectrum



File: CIFB_4th_Order_1.m

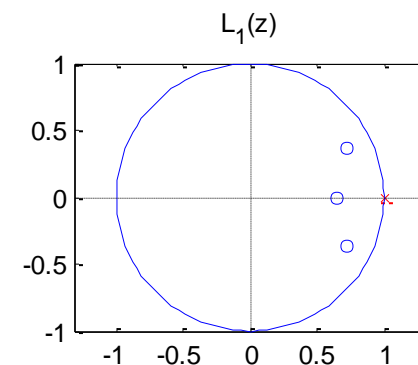
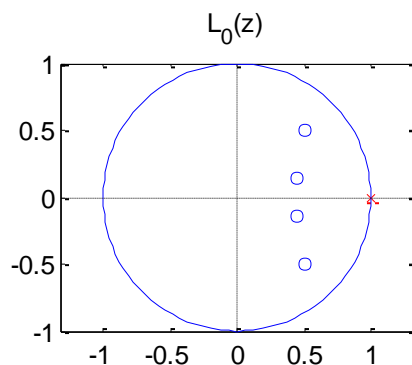
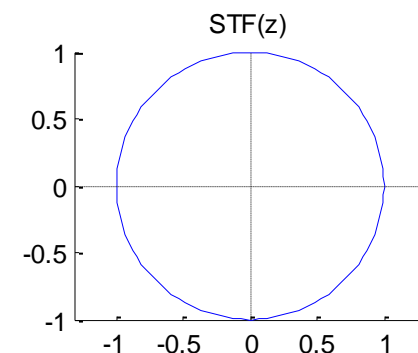
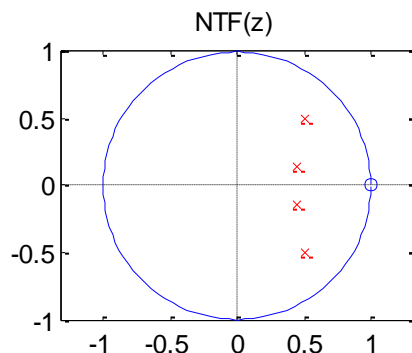
Other Examples of Feedback Topologies

- ❑ CRFB with single feed-in
 - CRFB_4th_Order_1.m
- ❑ Low-distortion CRFB topology
 - CRFB_4th_Order_2.m
- ❑ CIFB with single feed-in and optimized NTF zeros
 - CIFB_Opt_4th_Order_1.m
- ❑ Low-distortion CIFB topology with optimized NTF zeros
 - CIFB_Opt_4th_Order_2.m

File: CIFB_4th_Order_2.m

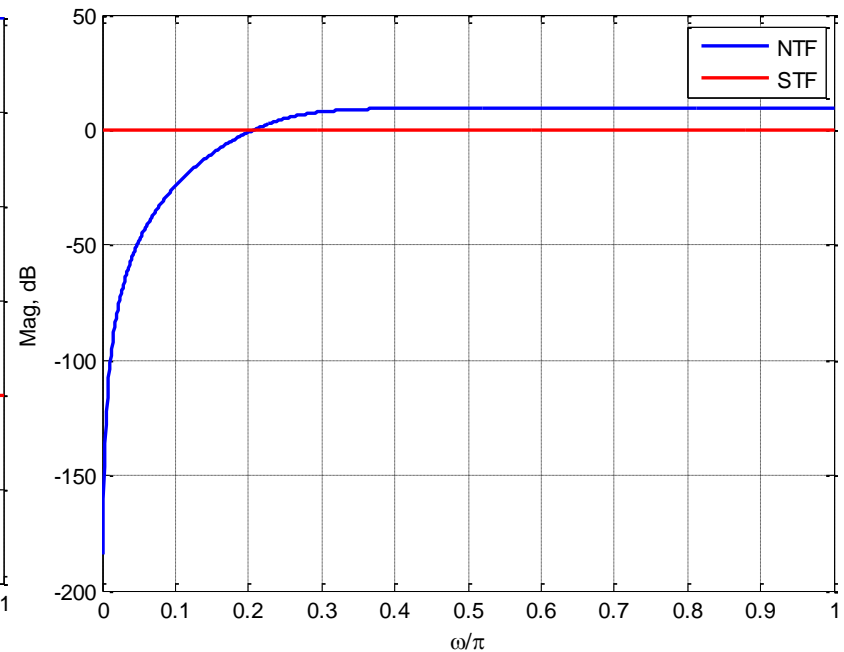
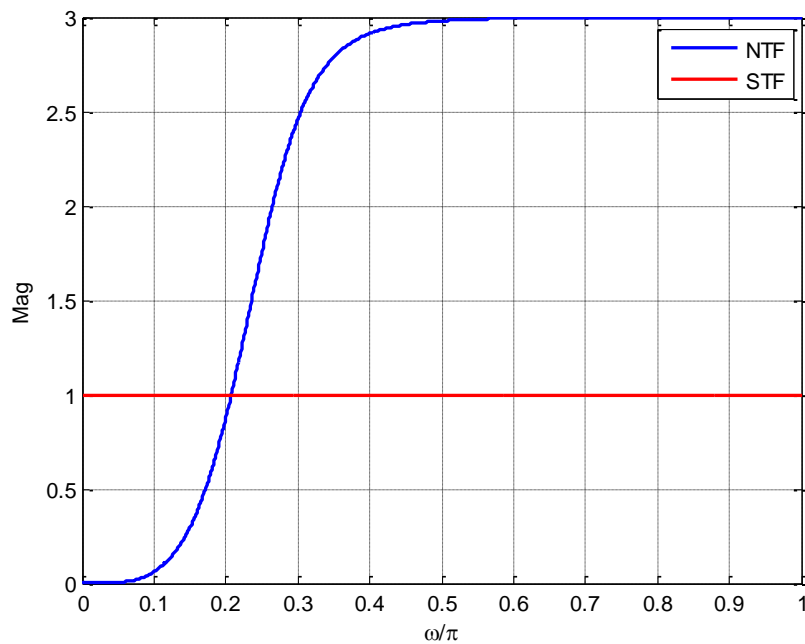
CIFF Example 1

- ❑ CIFF, order = 4
- ❑ All NTF zeros at $z=1$, i.e. $\text{opt} = 0$.
- ❑ OBG = 3, OSR = 16, $n\text{Lev} = 15$.
- ❑ Low-distortion topology
 - $b(1) = b(5) = 1$
 - $b(2:4) = 0$
- ❑ $\mathbf{a} = [2.1 \ 1.9 \ 0.86 \ 0.16]$
- ❑ $\mathbf{b} = [1 \ 0 \ 0 \ 0 \ 1]$
- ❑ $\mathbf{c} = [1 \ 1 \ 1 \ 1]$
- ❑ $\mathbf{g} = [0 \ 0]$



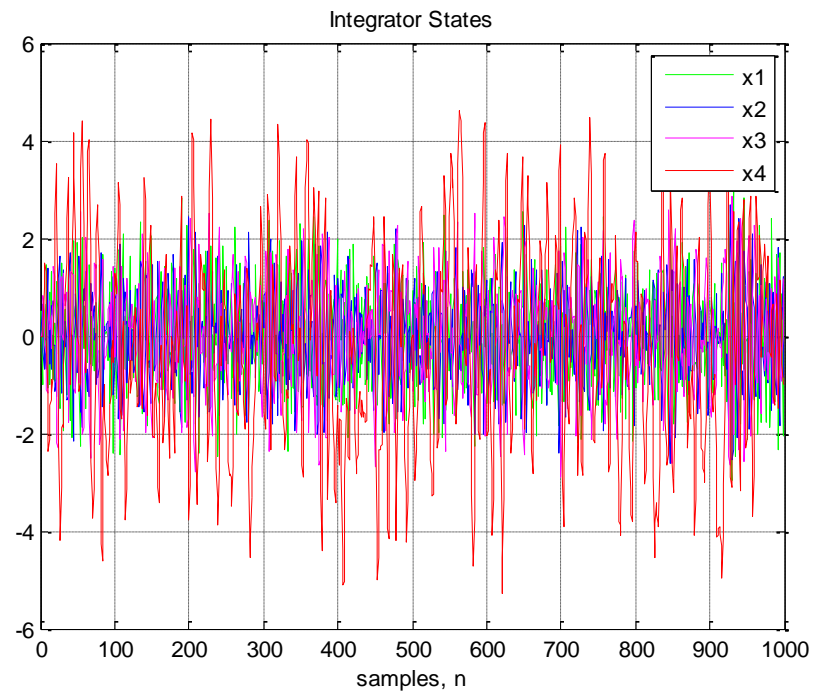
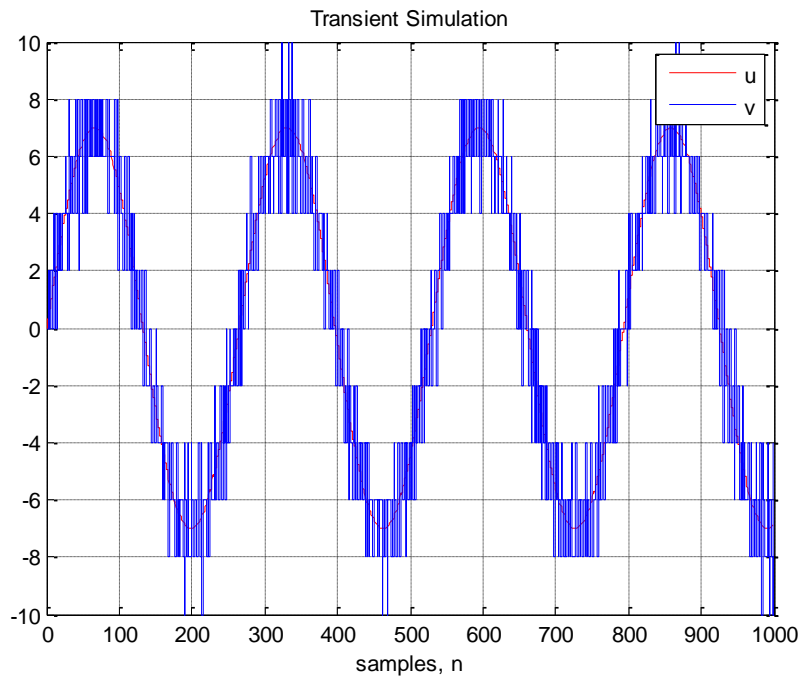
File: CIFB_4th_Order_1.m

CIFF Example 1 contd. : NTF and STF



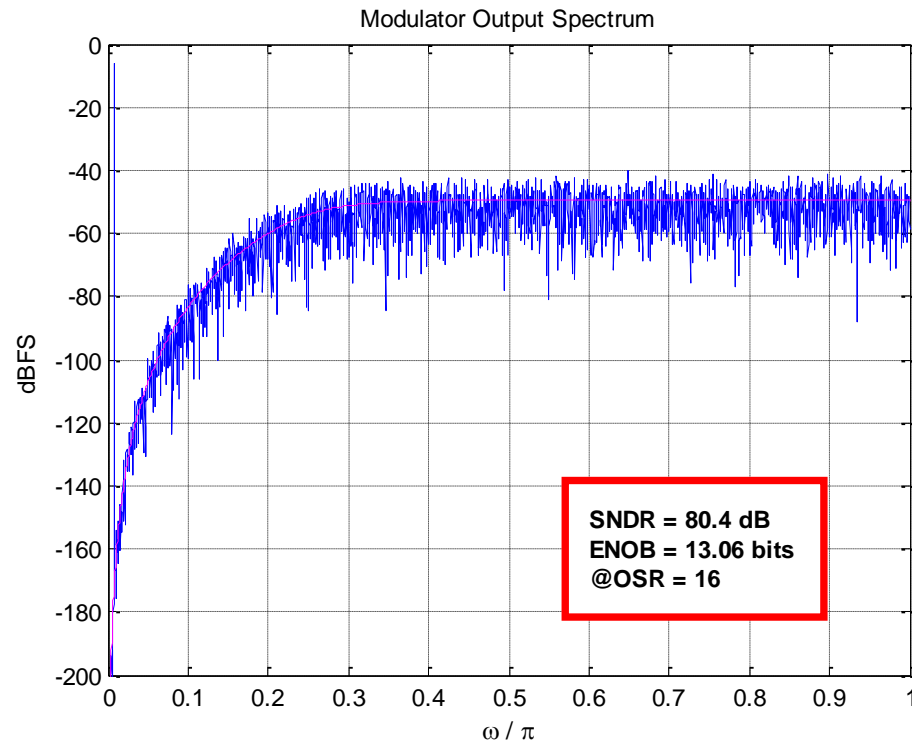
File: CIFF_4th_Order_1.m

CIFF Example 1 contd. : Loop-Filter States



File: CIFF_4th_Order_1.m

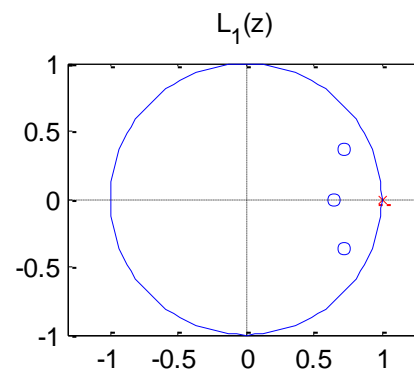
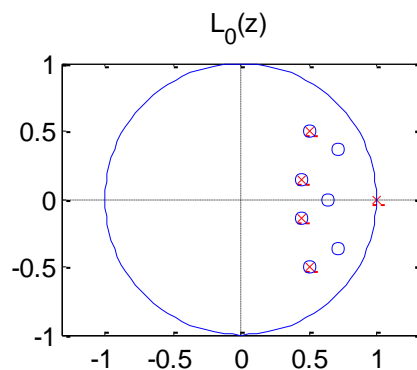
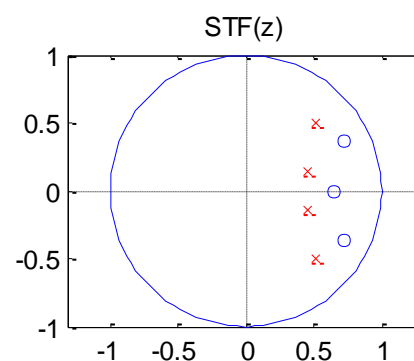
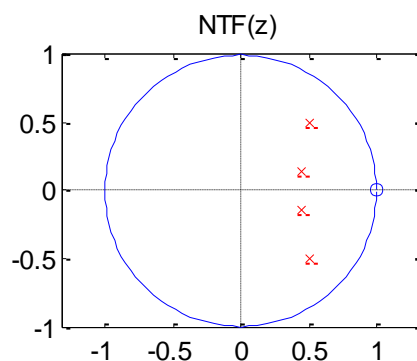
CIFF Example 1 contd. : Simulated Spectrum



File: CIFF_4th_Order_1.m

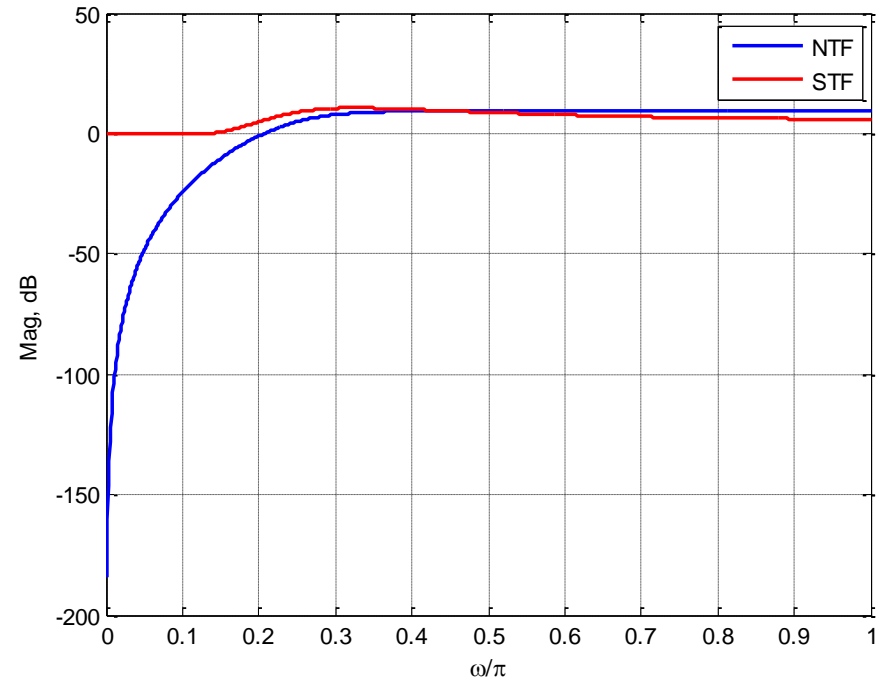
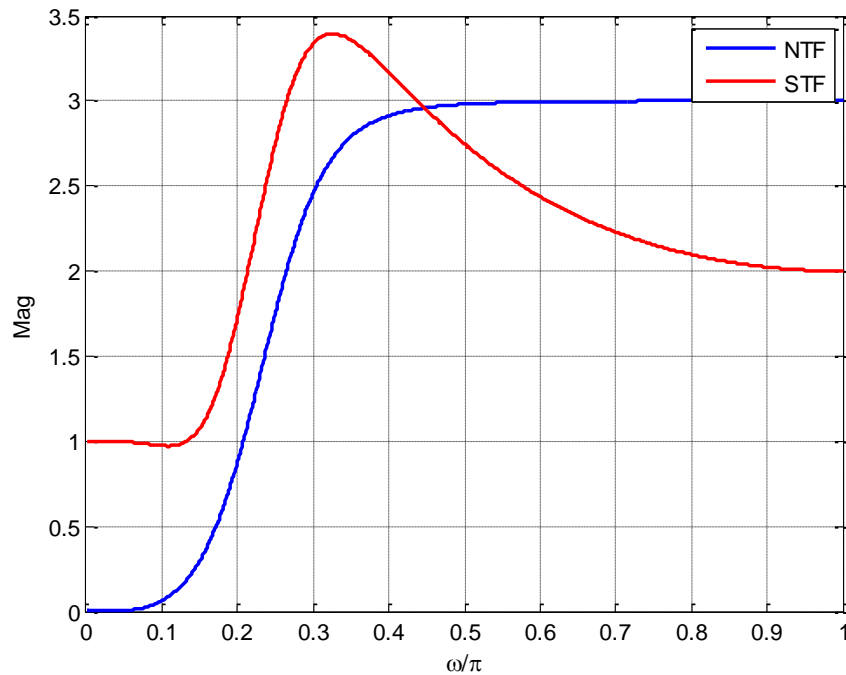
CIFF Example 2

- ❑ CIFF, order = 4
- ❑ All NTF zeros at $z=1$, i.e. $\text{opt} = 0$.
- ❑ OBG = 3, OSR = 16, $n\text{Lev} = 15$.
- ❑ Only single input feed-in used
 - $b(2:\text{end})=0$
- ❑ $\mathbf{a} = [2.1 \ 1.9 \ 0.86 \ 0.16]$
- ❑ $\mathbf{b} = [1 \ 0 \ 0 \ 0]$
- ❑ $\mathbf{c} = [1 \ 1 \ 1 \ 1]$
- ❑ $\mathbf{g} = [0 \ 0]$



File: CIFB_4th_Order_2.m

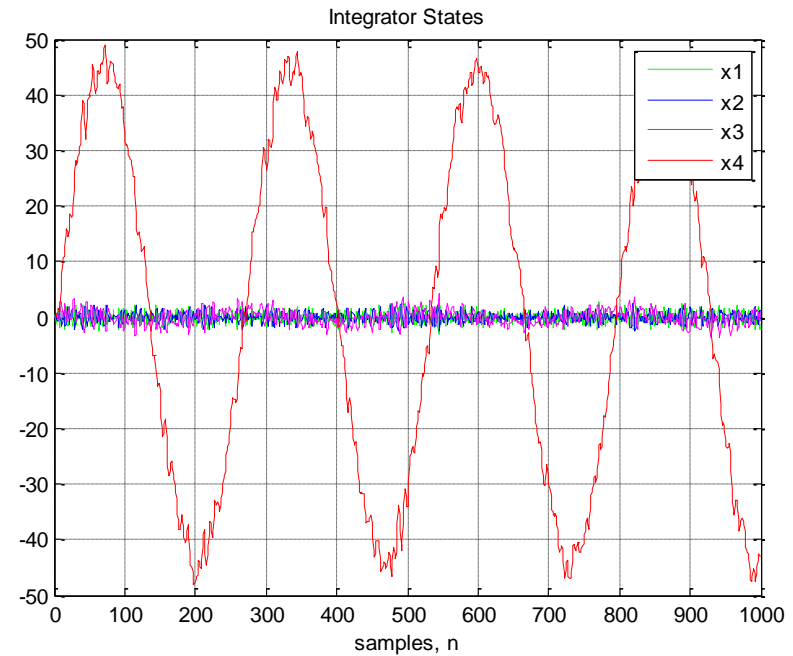
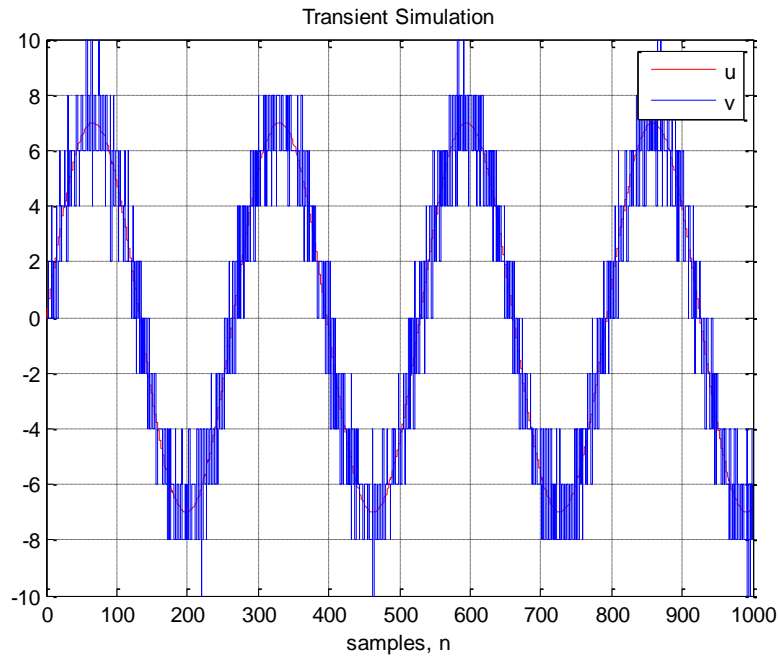
CIFF Example 2 contd. : NTF and STF



- Notice the significant STF peaking !

File: CIFF_4th_Order_2.m

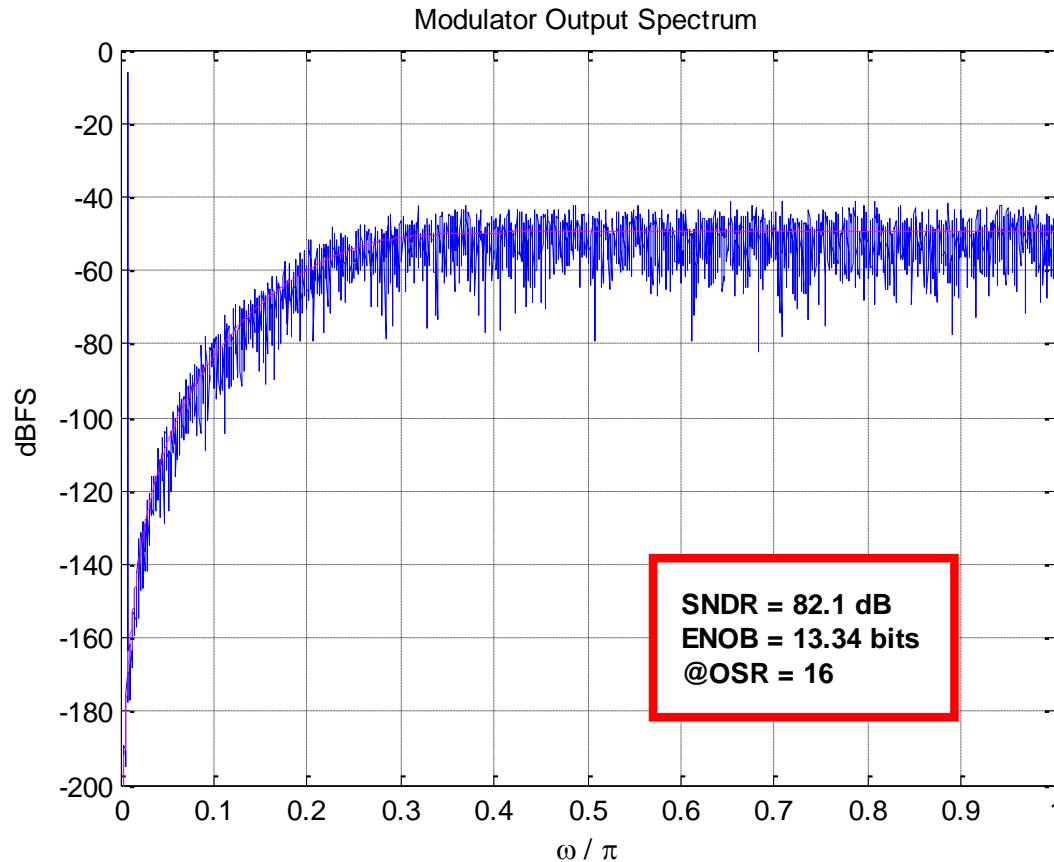
CIFF Example 2 contd. : Loop-Filter States



- Last integrator output has significant signal content
 - Use dynamic range scaling.
 - Last integrator will burn more power in this case.

File: CIFF_4th_Order_2.m

CIFF Example 2 contd. : Simulated Spectrum



File: CIFF_4th_Order_2.m

Other Examples of Feed-forward Topologies

- ❑ Low-distortion CRFF topology
 - CRFF_4th_Order_1.m
- ❑ CRFF with single feed-in
 - CRFF_4th_Order_2.m
- ❑ Low-distortion CIFF topology with optimized NTF zeros
 - CIFF_Opt_4th_Order_1.m
- ❑ CIFF with single feed-in and optimized NTF zeros
 - CIFF_Opt_4th_Order_2.m
- ❑ STF peaking in FF topologies with single feed-in is an issue
 - CT FF DSM will have STF peaking as full-feedforward branch can't be used.
 - The feed-in coefficients b 's can be strategically used to realize CIFF/CRFB topology with better out-of-band STF attenuation.