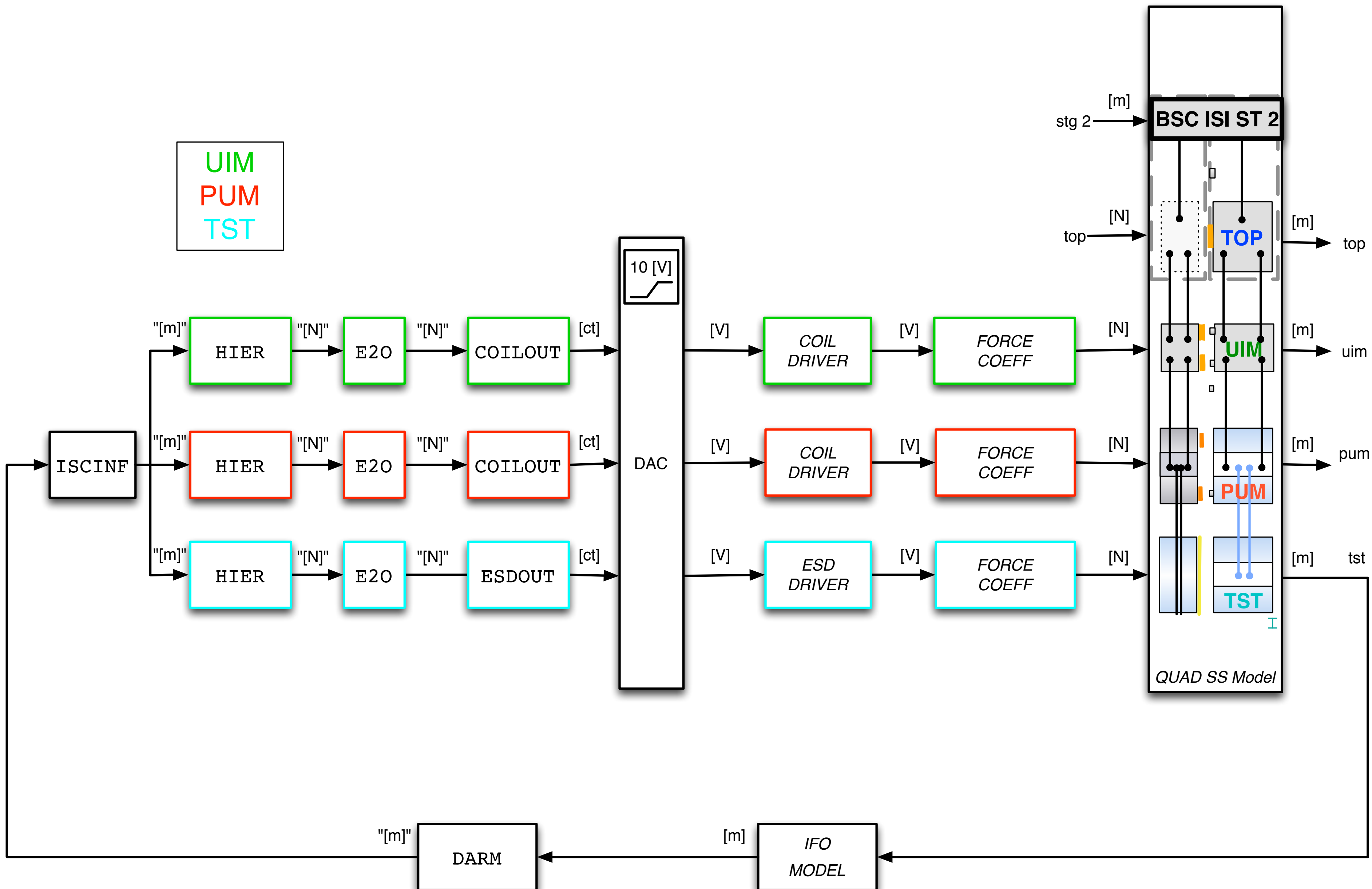
Hierarchical Control Notes – Blending Style

Follows quad example

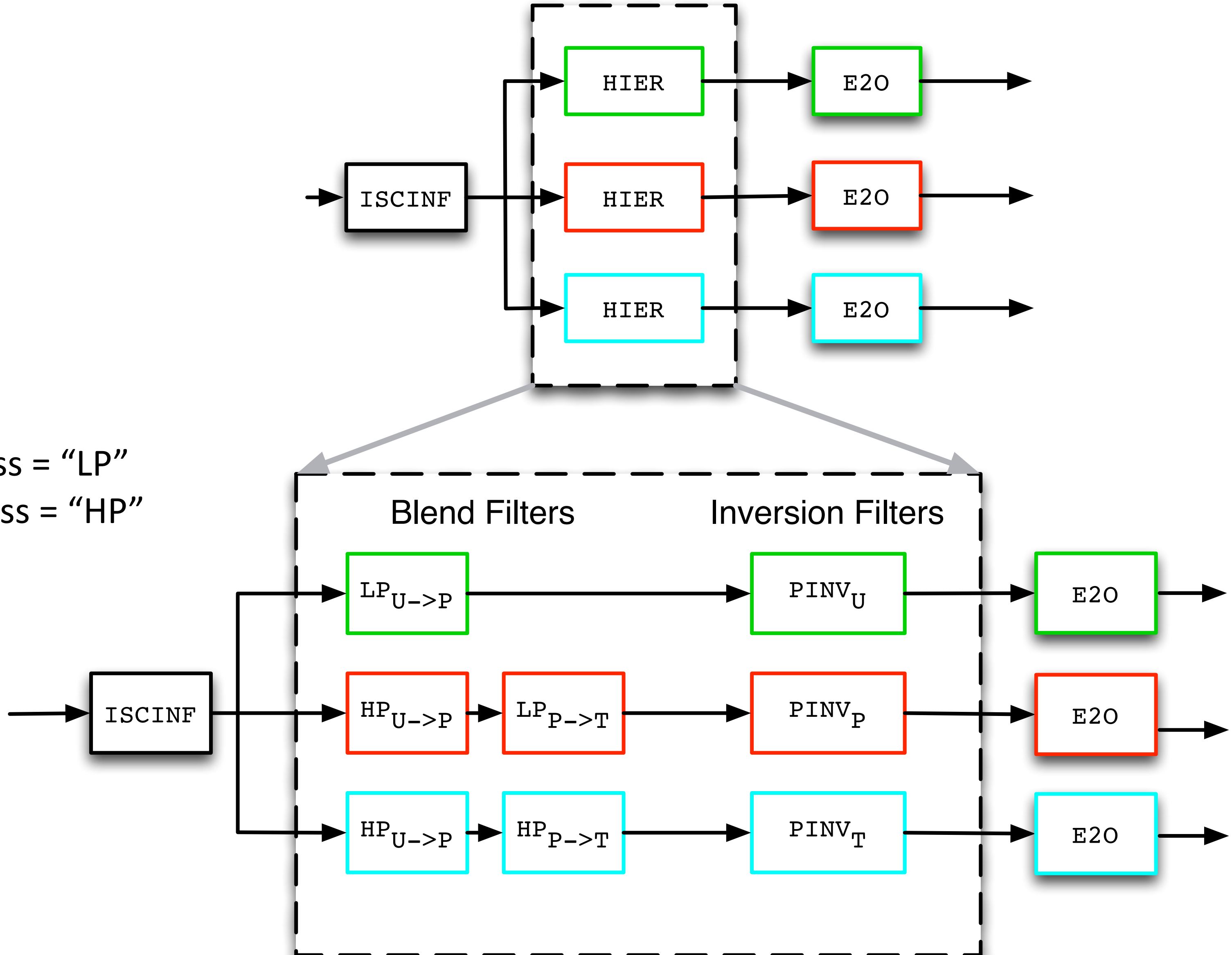
Note: coil drivers and ESD are LASTI style; seismic noise is outdated

Longitudinal Hierarchical Architecture



Longitudinal Hierarchical Architecture

Low Pass = “LP”
High Pass = “HP”



Complimentary Blend Filter Design

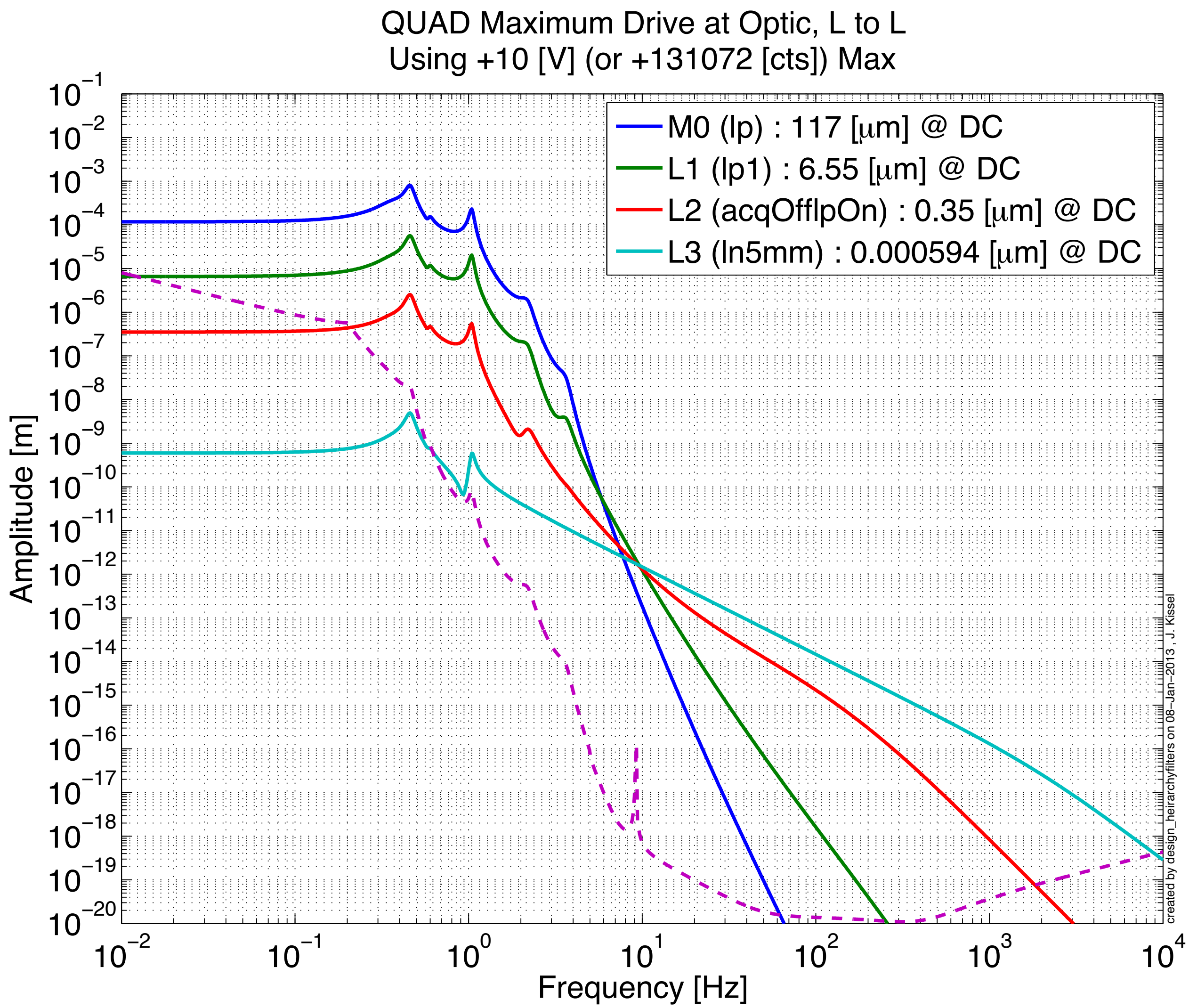
Blend Design Process:

- Chose blend frequencies based on actuator range cross overs

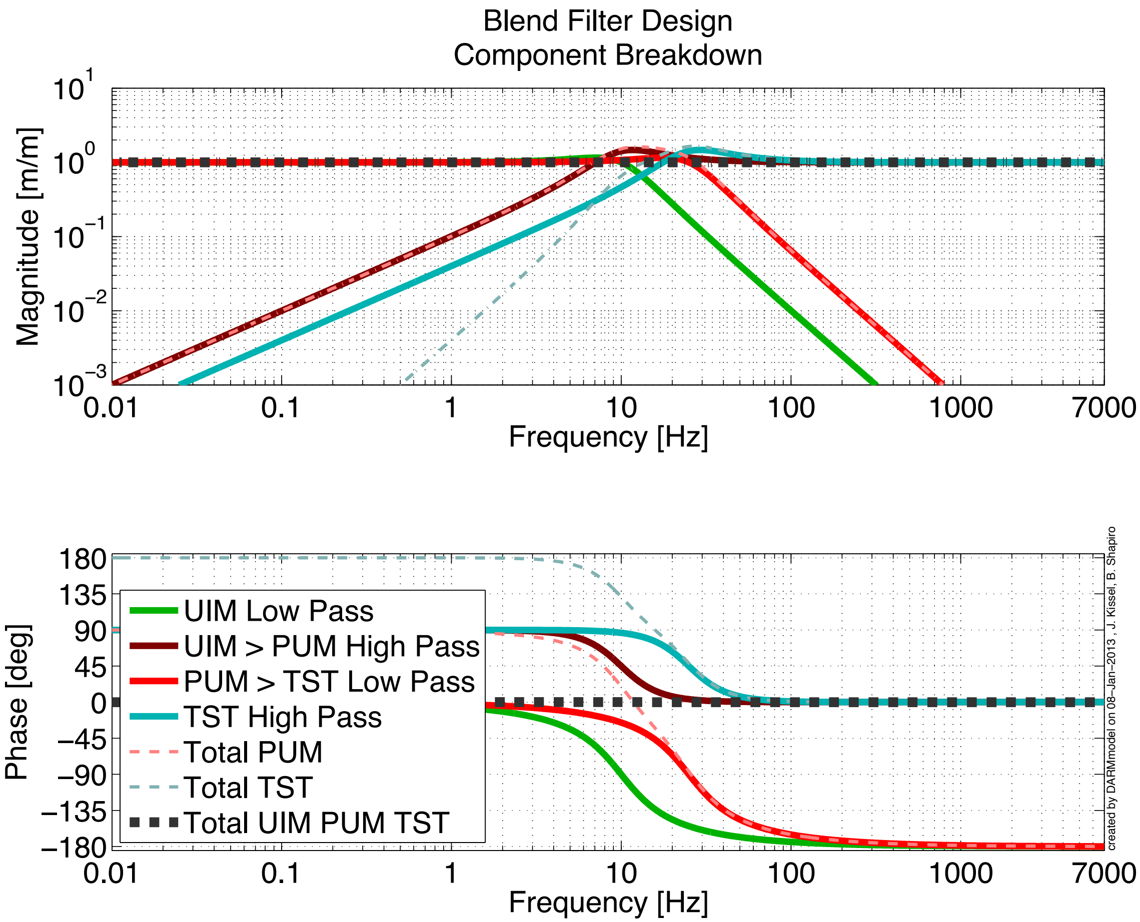
- The high pass filters are generated as compliments of the low pass filters, so only low pass filter design is needed

- Start building blends from UIM Low Pass ($LP_{U\text{->}P}$)

- Work your way through the filters down to TST Low Pass ($HP_{P\text{->}T}$)

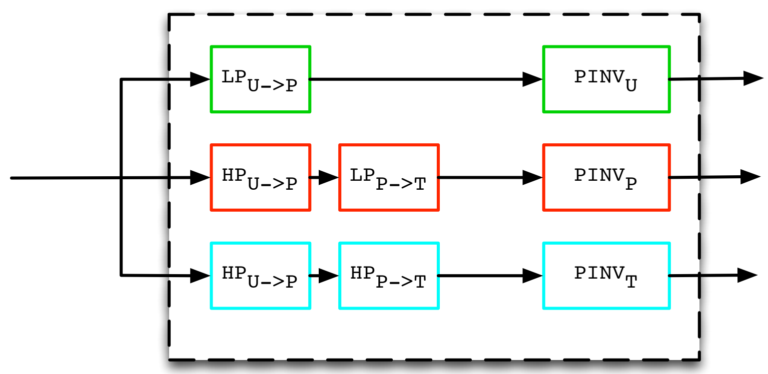


Complimentary Blend Filter Design

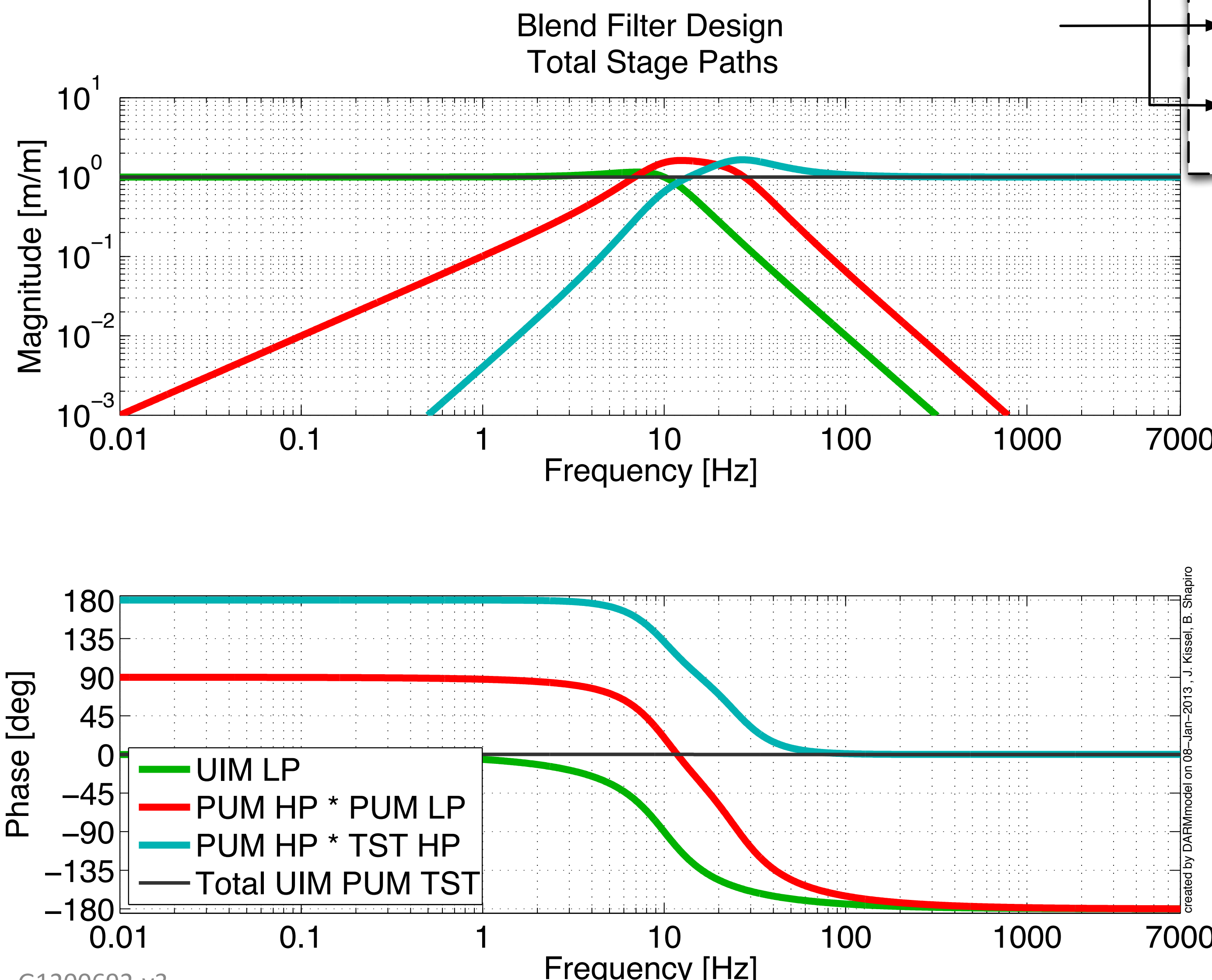


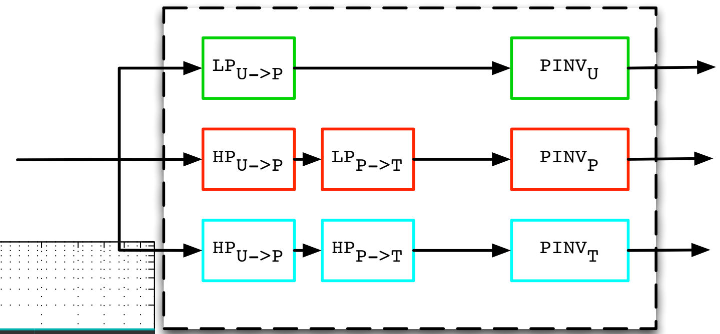
Our first attempt at the design:

- The UIM Low Pass ($LP_{U->P}$) is just a complex pair of poles at UIM / PUM crossover (@ 8 Hz, 60 deg phase)
- The PUM High Pass ($HP_{U->P}$) is the compliment of the UIM Low Pass
- The PUM Low Pass ($LP_{P->T}$) is a pair of complex poles at the PUM / TST crossover (@ 15 Hz, 60 deg phase)
- The TST High Pass ($HP_{P->T}$) is the compliment of the PUM Low Pass



Complimentary Blend Filter Design





- TOTAL sums to one
- Gain peaking is no more than 2
- PUM "band pass" comes up as f^2, false as 1/f^2
- TST High Pass comes up as f^4

Plant Inversion Filter Design

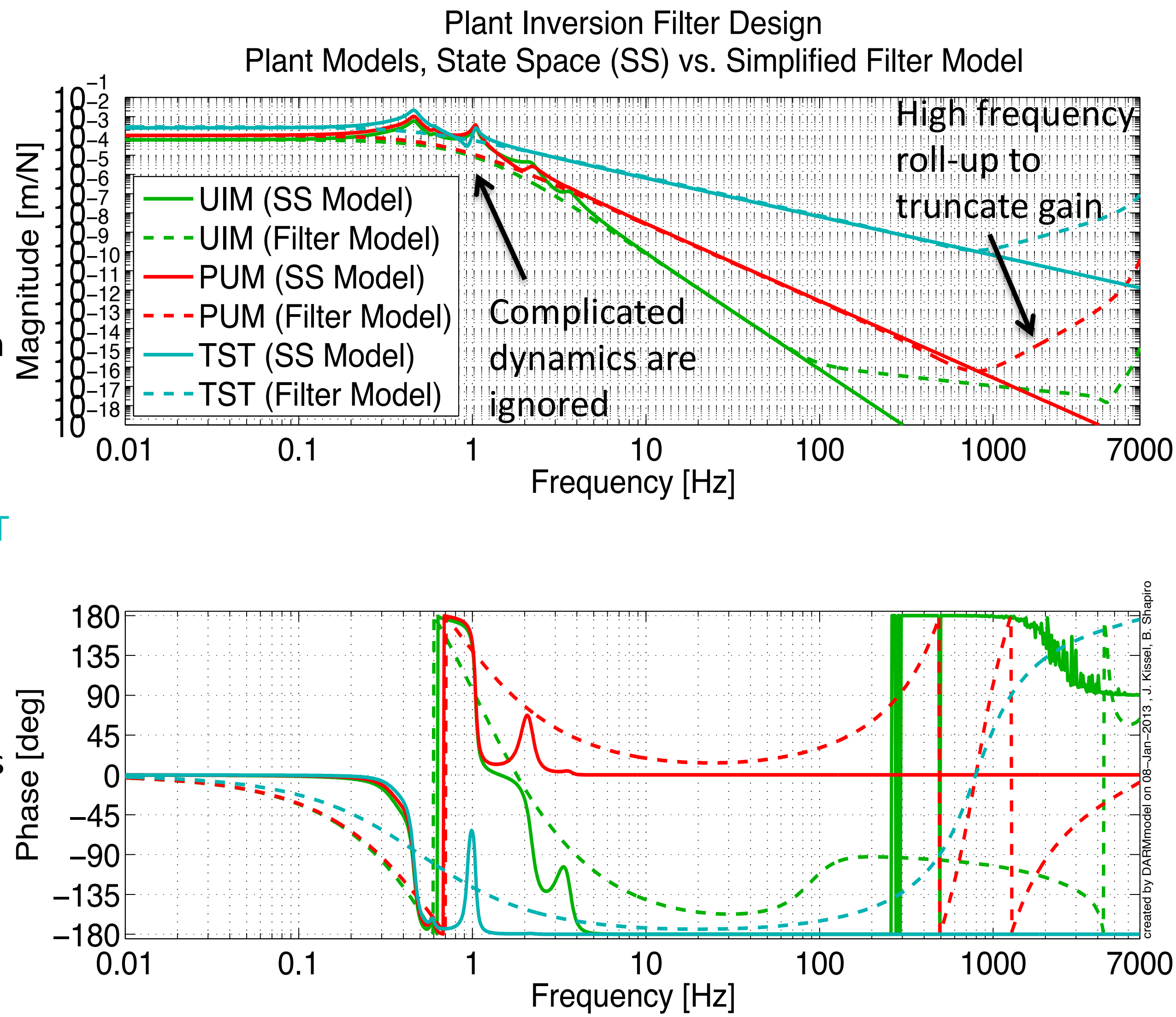
- Complimentary blending/ distribution only works if paths are in the same units in the region where the signals are blended

- As discussed in G1200632, ISC desires that “from the outside” the transfer function looks as TST Drive > TST Displacment transfer function

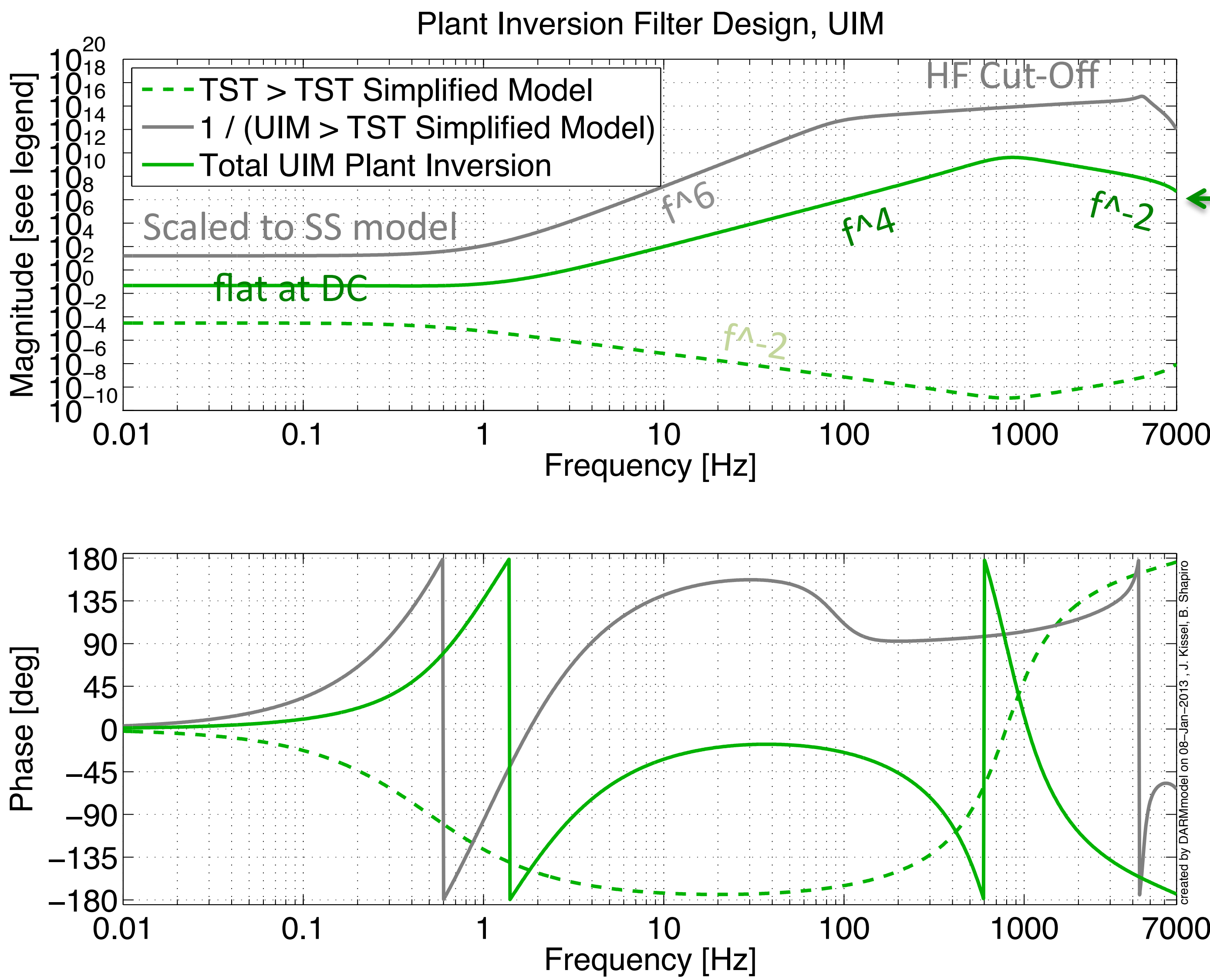
- So, must invert the *ratio* of dynamics between [UIM or PUM] Drive > TST disp and TST Drive > TST disp

- For starters, we use a simplified version of the model that ignores the complicated resonant dynamics (“fit” by hand, and scaled to match the State Space model)

- We do include a high-frequency roll-off so gain of inversion filter does not go to infinity



Plant Inversion Filter Design

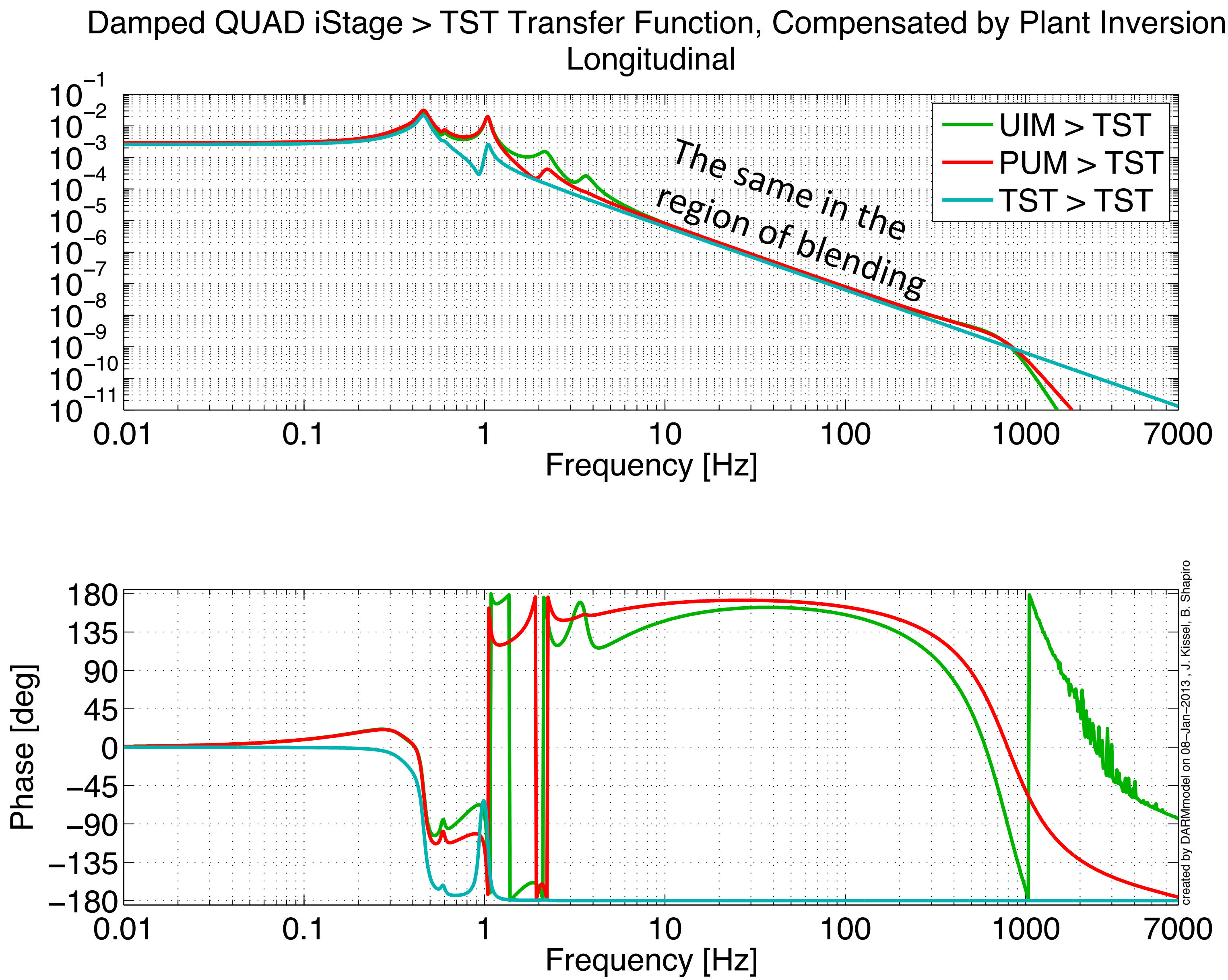


UIM Example

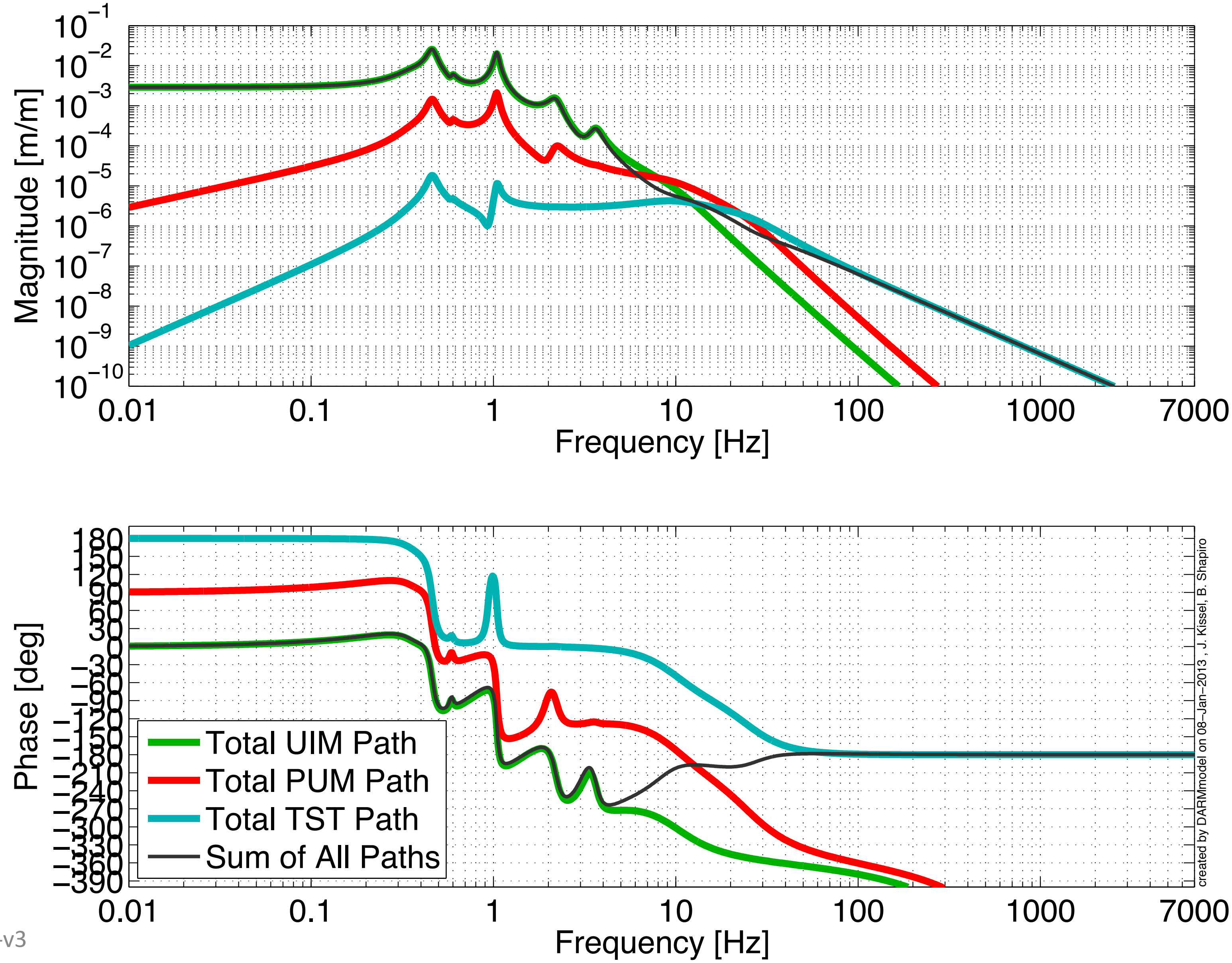
Total Plant Inversion Filter is ratio:
TST>TST / UIM > TST

Frequency (Hz)

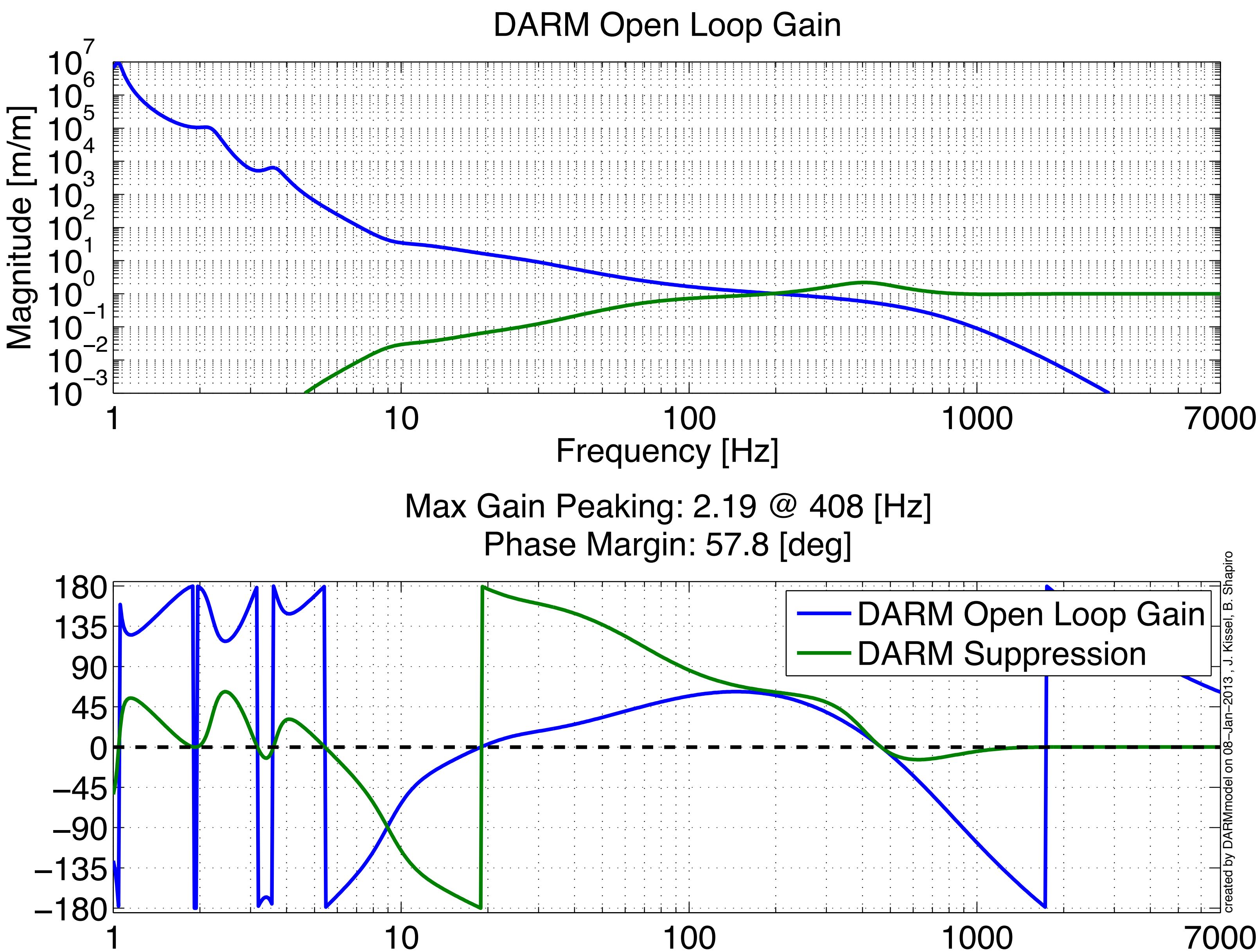
Plant Inversion Filter Design



Total Distributed Path Gain Stability Analysis

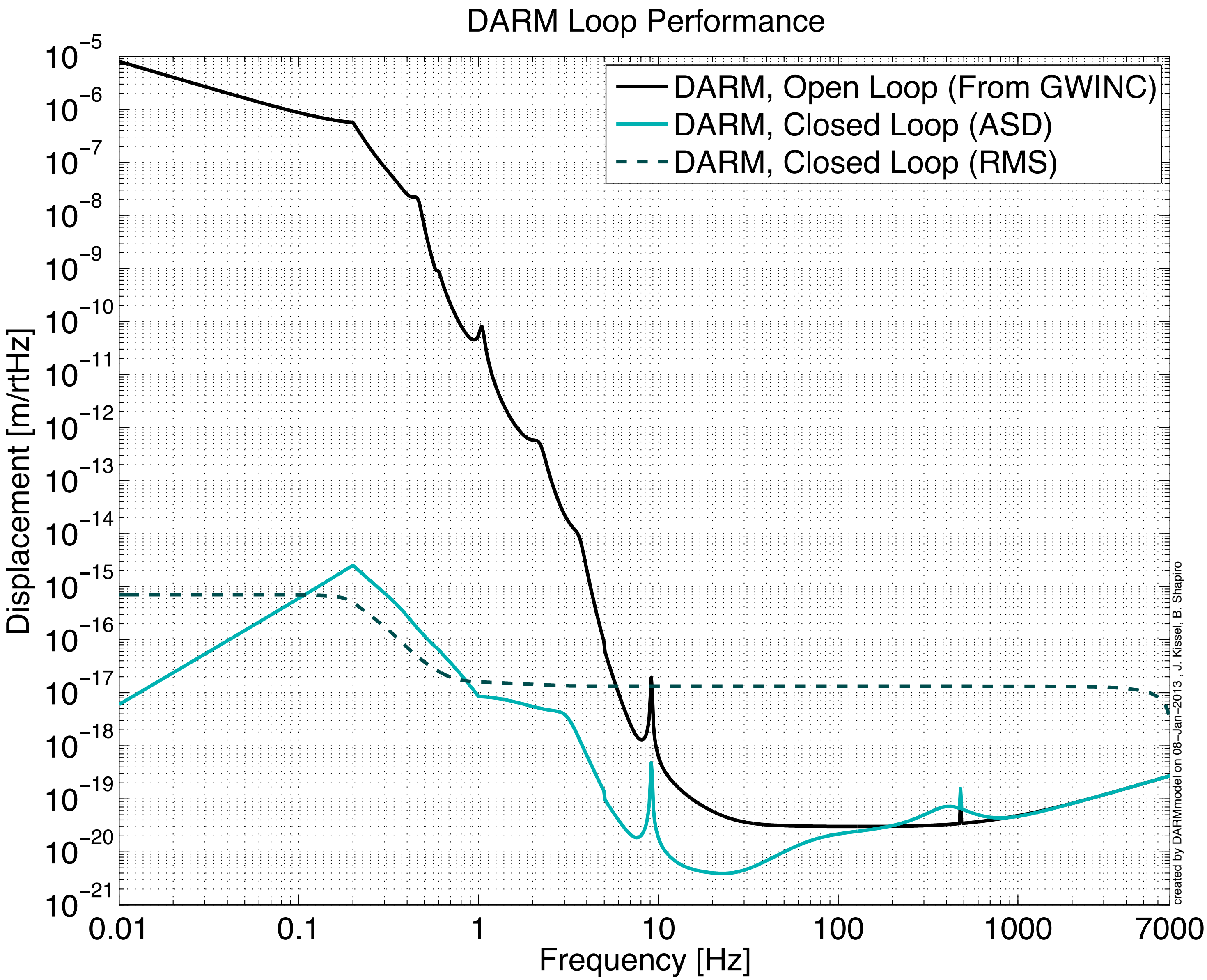


DARM Model



DARM Open Loop Gain
Magnitude [m/m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
1
10
100
1000
7000
Frequency [Hz]
Max Gain Peaking: 2.19 @ 408 [Hz]
Phase Margin: 57.8 [deg]
180
135
90
45
0
−45
−90
−135
−180
DARM Open Loop Gain
DARM Suppression
created by DARMmodel on 08−Jan−2013 , J. Kissel, B. Shapiro

DARM Model



DARM Loop Performance
DARM, Open Loop (From GWINC)
DARM, Closed Loop (ASD)
DARM, Closed Loop (RMS)
Displacement [m/rtHz]
Frequency [Hz]
0.01
0.1
1
10
100
1000
7000
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-16}
10^{-17}
10^{-18}
10^{-19}
10^{-20}
10^{-21}
created by DARMmodel on 08–Jan–2013 , J. Kissel, B. Shapiro

Closed Loop DAC voltages (10 V limit)