1. Frequency Compounding and k-space

Explore k-space and frequency compounding.

Examine frequency compounding with a Field II simulation of a -12dB cyst lesion phantom imaged with a 5 MHz, 128-element, lambda/2 element size, 75% bandwidth linear array. Use bandpass filtering of the received RF signal across the bandwidth of the transducer, forming two or more sub-bands.

You may us the Matlab FDATool of the command line filter design functions.

Show the k-space magnitudes for the unfiltered RF data and each sub-band. Create uncompounded and compounded detected images and report their speckle SNR (mu/sigma). Find the correlation between the two or more sub-bands using data in each domain (via cross-correlation and multiplication, respectively). Find the axial resolution via autocorrelation, using a kernel and search region in the speckle pattern. Graph the axial resolution versus the speckle SNR (mu/sigma) and examine contrast-to-noise ratio (CNR) of the cyst.

Code is given to find the k-space region of support from a point spread function from a point target in a Field II simulated phantom.

For your Exercise, you will use focused element channel data that are saved in the Matlab file “sampleData.mat". The Matlab script "loadData.m" shows the content structures of the data file.

See the data files, code and papers on CampusNet in the folder “File Sharing”, “exercises”, “exercise_1_k_space”.

[1] Walker, W. F., & Trahey, G. E. (1998). The application of k-space in pulse echo ultrasound. *Ultrasonics, Ferroelectrics, and Frequency Control, IEEE Transactions on*, *45*(3), 541-558.

Advisor: Gregg Trahey, PhD; David Bradway, PhD