22485 Medical Imaging systems

Notes on exercise 3 and 4

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Exercise 3 about generating ultrasound RF flow data

Basic model, first emission:

$$r_1(t) = p(t) * s(t)$$

$s(t)$ - Scatterer amplitudes (white, random, Gaussian)

Second emission:

$$r_2(t) = p(t) * s(t - t_s) = r_1(t - t_s)$$

Time shift t_s:

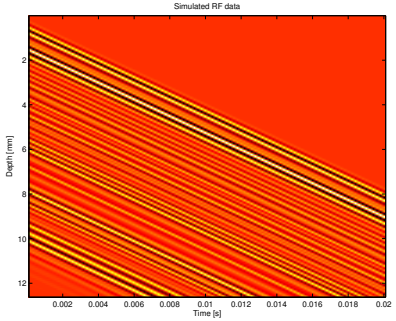
$$t_s = \frac{2v_z}{c} T_{prf}$$

$r_1(t)$	Received voltage signal	$p(t)$	Ultrasound pulse
$*$	Convolution	v_z	Axial blood velocity
c	Speed of sound	T_{prf}	Time between pulse emissions

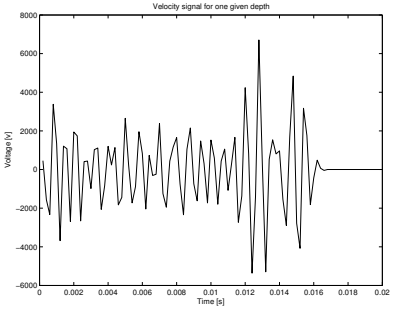
Signal processing

1. Find ultrasound pulse (load from file)
2. Make scatterers
3. Generate a number of received RF signals
4. Study the generated signals
5. Compare with simulated and measured RF data

Results for simulated data

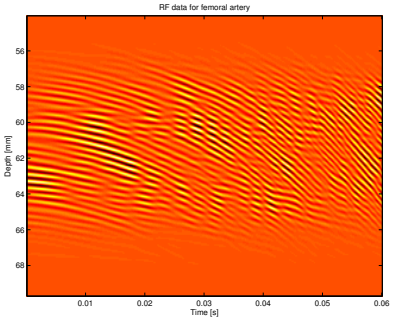


Matrix of simulated RF data

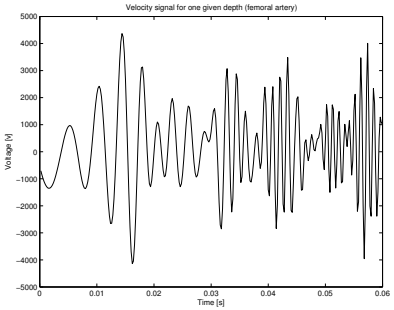


Sampled data from one depth

Results for femoral artery

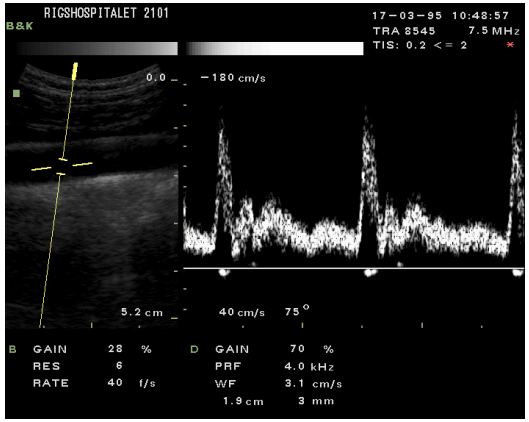


Matrix of measured RF data



Sampled data from one depth

Spectrogram from carotid artery



Exercise 4: signal processing in pulsed wave system in the data bar

1. Process receive signal to get complex data (load from file)
2. Divide into overlapping segments
3. Calculate power spectrum (apply compression)
4. Display the spectra as a function of time
5. Compare the spectra for different vessels