Tissue Doppler ultrasound imaging (TDI) enables the estimation of cardiac function by transmitting streams of pulses in a certain direction and estimating the velocity of the tissue from the phase shifts of the returning echoes. Recently, Xampling and Compressed Sensing methods developed at SAMPL were applied to TDI, allowing the reconstruction of signals sampled at a sub-Nyquist rate with reduced number of pulses per velocity estimation, using priors on the sparsity of the signal. This reduced sampling was performed without compromising the temporal and spatial resolutions.

Currently, TDI imaging enables the estimation of the component of cardiac velocity parallel to the transmitted ultrasonic beam. Therefore, TDI measurements depends on the scan angle and thus suffer from high variability. Several methods have been developed in the last few years for the estimation of the full flow field including the transverse component, collectively known as vector Doppler imaging methods.

In the first part of this project, estimators for the full 2d velocity field were invastigated and implemented. In this project, sub-Nyquist TDI system incorporating vector Doppler imaging will be implemented using new programmable research ultrasound platform. The system developed in this project will pave the way for future high-end portable ultrasound systems enabling reliable quantification of cardiac function.

In this project you will become familiar with Xampling and Compressed Sensing theory and novel ultrasonic signal processing methods. In addition, you will gain experience in implementing signal processing algorithms on real ultrasound systems.

**Required background**: Matlab, Introduction to Digital Signal Processing.

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