Synthetic Aperture Beamformation using the GPU

A synthetic aperture ultrasound beamformer is implemented for a GPU using the OpenCL framework. The implementation supports beamformation of either RF signals or complex baseband signals. Transmit and receive apodization can be either parametric or dynamic using a fixed F-number, a reference, and a direction. Images can be formed using an arbitrary number of emissions and receive channels. Data can be read from Matlab or directly from memory and the setup can be configured using Matlab. A large number of different setups has been investigated and the frame rate measured. A frame rate of 40 frames per second is obtained for full synthetic aperture imaging using 16 emissions and 64 receive channels for an image size of 512x512 pixels and 4000 complex 32-bit samples recorded at 40 MHz. This amount to a speed up of more than a factor of 6 compared to a highly optimized beamformer running on a powerful workstation with 2 quad-core Xeon-processors.