

**Purpose:** To accelerate computation speed of time-consuming voxelwise hepatic perfusion estimation from dynamic contrast enhanced (DCE) imaging using graphics processing unit (GPU) hardware, thus facilitating high resolution DCE analysis of large tissue regions for perfusion assessment.

**Methods:** Voxelwise perfusion estimation for large tissue regions are assigned to a GPU for parallel computation with a CUDA block for one voxel computation. The Nelder-Mead simplex algorithm for the nonlinear least squares fitting of a hepatic kinetic model is executed in each block. To compute the convolution in the cost function in frequency domain, the general Cooley-Tukey algorithm with the radix-2 inverse FFT is implemented in a block. The algorithms are programmed using CUDA 3.2 on the GPU of NVIDIA's Tesla C2050. Simulated dynamic curves are used to evaluate the GPU implementation. The computation time of the GPU perfusion estimation per voxel is compare with that from a CPU. By varying the number of time points in the dynamic curves, we also examine the performance improvement with respect to the share memory usage.

**Results:** The perfusion estimation with single precision float GPU computation has accuracy of greater than 99% of the truth. The GPU implementation is approximately 30 times faster than the CPU computation for the number of voxels greater than 100. The result also shows less share memory usage produces higher performance.

**Conclusions:** We implement the voxelwise hepatic perfusion estimation from DCE imaging on GPU, which significantly accelerates the computation speed. Further optimization of the GPU codes, such as share memory usage, will improve the performance. The GPU programs are valuable for a study of liver perfusion after irradiation as well as useful for other DCE imaging modeling for high performance. The work is supported in part by PO1CA59827 and RO1CA132834.