GPU accelerated best curve approximation in pill identification

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The increasing success of general purpose GPUs in general computing and also in high performance computing is unquestioned. We will present the suitability of GPUs in the "pill identification problem", (see [1], [2] and [3]), which might be considered as a representative example for parallelization of many identical sequential optimization problems. For this purpose we will examine a sub problem on a GPU and then compare the performance of the "parallel pill identification algorithm" (see [4]) implemented as C++ CPU-only version using openMPI and as C++ CPU/GPU version using openMPI and CUDA It turned out, that the CPU/GPU approach, under some restrictions, is faster than the CPU-only approach by a factor between 60 and 200.

The curve approximation itself is based alternatively on polynomial approximation or circular splines [5] and the best curve for the given 3D data point should result in a linear regression between the arc length of the curve (wrt. projected data points) [6] and the concentration value assigned to that point. The resulting functional for one curve is minimized by a Quasi-Newton method with an Inverse-BFGS-Update [7]. Instead of performing a line search with the commonly used strategies, a rather naive approach prove to be much more efficient for our use on GPUs.

References:

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