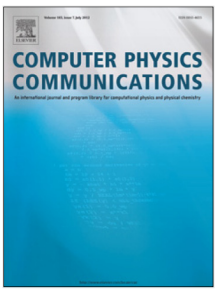
Accepted Manuscript



Real-time computation of parameter fitting and image reconstruction using graphical processing units

Uldis Locans, Andreas Adelmann, Andreas Suter, Jannis Fischer, Werner Lustermann, Günther Dissertori, Qiulin Wang

PII: S0010-4655(17)30049-8
DOI: http://dx.doi.org/10.1016/j.cpc.2017.02.007
Reference: COMPHY 6155

To appear in: *Computer Physics Communications*

Received date : 11 April 2016
Revised date : 22 November 2016
Accepted date : 12 February 2017

Please cite this article as: U. Locans, et al., Real-time computation of parameter fitting and image reconstruction using graphical processing units, *Computer Physics Communications* (2017), http://dx.doi.org/10.1016/j.cpc.2017.02.007.

Real-Time Computation of Parameter Fitting and Image Reconstruction Using Graphical Processing Units

Uldis Locans[a,c], Andreas Adelmann[a,*], Andreas Suter[a], Jannis Fischer[b], Werner Lustermann[b], Günther Dissertori[b], Qiulin Wang[b,d]

[a] *Paul Scherrer Institut, Villigen, CH-5232, Switzerland*
[b] *ETH Institut für Teilchenphysik, CH-8092, Switzerland*
[c] *University of Latvia, 19 Raina Blvd., Riga, LV 1586, Latvia*
[d] *Tsinghua University Institute of Medical Physics, Bejing, China*

Abstract

In recent years graphical processing units (GPUs) have become a powerful tool in scientific computing. Their potential to speed up highly parallel applications brings the power of high performance computing to a wider range of users. However, programming these devices and integrating their use in existing applications is still a challenging task.

In this paper we examined the potential of GPUs for two different applications. The first application, created at Paul Scherrer Institut (PSI), is used for parameter fitting during data analysis of μSR (muon spin rotation, relaxation and resonance) experiments. The second application, developed at ETH, is used for PET (Positron Emission Tomography) image reconstruction and analysis. Applications currently in use were examined to identify parts of the algorithms in need of optimization. Efficient GPU kernels were created in order to allow applications to use a GPU, to speed up the previously identified parts. Benchmarking tests were performed in order to measure the achieved speedup.

During this work, we focused on single GPU systems to show that real time data analysis of these problems can be achieved without the need for large computing clusters. The results show that the currently used application for parameter fitting, which uses OpenMP to parallelize calculations over multiple CPU cores, can be accelerated around 40 times through the use of a GPU. The speedup may vary depending on the size and complexity of the problem. For PET image analy-

*Corresponding author
Email address: andreas.adelmann@psi.ch (Andreas Adelmann)