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To my family and friends

Abstract

During most recent years we have witnessed a fast paced evolution of computer graphics hardware. The rapid developments mainly concerned the highly specialized processing units, their memory bandwidths, as well as their programmability. As large computing resources are a highly demanded in most scientific computing disciplines, graphics processors have entered various areas far beyond computer graphics. This thesis investigates the use of GPU computing in the field of medical imaging with a focus on image segmentation and registration. The presented work surveys advancements in both fields and contributes new algorithms and methodologies to each of them.

Zusammenfassung

In den vergangenen Jahren konnte eine rapide Veränderungen im Bereich Computergrafik und Grafikhardware beobachtet werden. Den Kern dieser Entwicklung bilden hoch spezialisierte und dadurch sehr performante Grafikprozessoren und deren zunehmende Programmierbarkeit. Wegen ihrer herausragenden Performance bei parallelisierbaren Problemen, wurden Grafikprozessoren in jüngster Vergangenheit vermehrt für wissenschaftliche, nicht Computergrafik-bezogene Probleme eingesetzt. Die vorliegende Arbeit untersucht den Einsatz von Grafikprozessoren im Bereich der medizinischen Bildverarbeitung mit einem Fokus auf Bildsegmentierung und -registrierung. Neben dem Ziel, einen Überblick über beide Gebiete zu verschaffen, werden neue Algorithmen und Methoden zu beiden Gebieten vorgestellt und evaluiert.

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During an internship at Siemens Corporate Research (SCR) my supervisor Dr. Shmuel Aharon introduced me to the field of GPU computing. After working on this topic for several months, he offered me a position as Ph.D. student at SCR. Coming from a German univeristy of applied sciences (Fachhochschule), which may not award doctoral degrees, I first faced the challenge of finding a professor who would be interested in remotely advising me in this newly emerging topic. I hereby finally have the chance to thank Dr. Aharon and Prof. Dr. Preim from the University of Magdeburg for giving me this opportunity. After Dr. Aharon left SCR I also had the great pleasure of working with Dr. Ali Khamene. During all these times, I received a great amount of freedom. As much as I enjoyed this, I would like to say that it tought me lessons about discipline, self-motivation, and the importance of networkig. Speaking of, I would like to thank my colleagues and colaborators. Even though this list is not complete, I would like to thank Christoph Vetter, Dr. Daniel Cremers, Mamadou Dialo, and Dr. Thomas Schwiwietz for advices and discussions.
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