Magdeburger Schriften zur Visualisierung

herausgegeben von
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Band 5

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GPU-based Medical Image Segmentation and Registration

Shaker Verlag
Aachen 2010

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Zugl.: Magdeburg, Univ., Diss., 2010

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Printed in Germany.

ISBN 978-3-8322-9426-7
ISSN 1865-7397

Shaker Verlag GmbH • P.O. BOX 101818 • D-52018 Aachen
Phone: 0049/2407/9596-0 • Telefax: 0049/2407/9596-9
Internet: www.shaker.de • e-mail: info@shaker.de

GPU-based Medical Image Segmentation and Registration

With the constant improvement in acquisition workflow and image quality, medical images have been utilized for intra-operative purposes, i.e. guidance of interventions. Research in the area of medical imaging and visualization aims to add new dimensions to a physician's field of view for more effective planning, conducting, and evaluation of interventions. Besides improved and more sophisticated algorithms, a trend in medical imaging is an increase of data sizes towards more detailed images. Both trends, while striving to improve treatment planning and conduction, often demand an increase in computational resources to ensure timely processing. A challenge that often can not be overcome using traditional software implementations.

However, 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 highly demanded in most scientific computing disciplines, graphics processors have entered various areas far beyond computer graphics.

The presented work gives an introduction to GPU computing paradigms and programming interfaces before surveying advancements in the fields of GPU-based medical image processing. The author focuses particularly on image segmentation and registration while organizing each discipline in a separate chapter. Major parts of these chapters are novel algorithms and methodologies developed by the author and his colleagues. Numerous tables are given as overviews of different aspects of the field. Moreover, a chapter about software design considerations for frameworks integrating various GPU hardware generations is part of this book.