Natural Sciences and Engineering Research Council of Canada

Conseil de recherches en sciences naturelles et en génie du Canada

Date 2009/07/27

Notification of Intent to Apply for a Discovery Grant

Avis d'intention de présenter une demande de subvention à la découverte

APPLICANT / CANDIDAT

Family name / Nom de famille	Given name / Prénom	Initial(s) of all given names / Initiale(s) de tous les prénoms	Personal identification no. (PIN) / N° d'identification personnel (NIP)
Heidrich	Wolfgang	W.	**Valid/Valide** 242351

Department (at the time of application) / Département (au moment de présenter votre demande)	Institution (where you will hold your grant) / Établissement (où vous détiendrez la subvention)
Department of Computer Science	The University of British Columbia

E-mail address / Adresse de courriel

heidrich@cs.ubc.ca

Degrees Diplômes	Discipline Discipline	University Établissement	Supervisor Directeur de travaux	Year Année
Master's / Maîtrise	Computer Science	Waterloo	Richard Bartels, George Labahn	1996
Doctorate / Doctorat	Computer Science	Friedrich-Alexander Univ Erlangen-Nürnberg	Hans-Peter Seidel	1999
Postdoctoral experience / Expérience postdoctorale	Computer Science	Max-Planck-Institut f. Informatik	Hans-Peter Seidel	1999 - 2000

EVALUATION GROUP ASSIGNMENT / ASSIGNATION DU GROUPE D'ÉVALUATION

Suggest the number of the evaluation group you feel should review your application. / Entrez le numéro du groupe d'évaluation qui selon vous devrait évaluer votre demande.

1507

NOTE / Remarque : NSERC makes the final evaluation group assignment.
L'assignation finale à un groupe d'évaluation revient au CRSNG.

APPLICATION INFORMATION / RENSEIGNEMENTS SUR LA DEMANDE

TYPE OF APPLICATION / TYPE DE DEMANDE

Title of proposal / Titre de la proposition
Computational imaging for graphics and vision

Individual / Individuelle	**X**
Team / Équipe	
Project (for Subatomic Physics only) / Projet (pour physique subatomique seulement)	

Research topic(s) that describe the proposed research
Sujets de recherche décrivant la recherche proposée

CS19, CS21

The application will be submitted in / La demande sera présentée en

[X] English / anglais   [ ] français / French

KEY WORDS that best describe the proposed research / MOTS CLÉS qui décrivent le mieux la recherche proposée

imaging, 3D scanning, fluid imaging, computational photography, computational cameras & optics, tomography

Canada

SUMMARY OF PROPOSAL / RÉSUMÉ DE LA PROPOSITION

In the space provided below, state the objectives of the proposed research program and summarize the scientific approach, highlighting the novelty and expected significance of the work to a field or fields in the natural sciences and engineering. Note that NSERC supports research in the natural sciences and engineering (other than the health sciences).

Dans l'espace prévu ci-dessous, énoncez les objectifs du programme de recherche proposé et résumez la démarche scientifique, en soulignant l'originalité et l'importance prévue des travaux dans un ou plusieurs domaines des sciences naturelles ou du génie. Veuillez noter que le CRSNG appuie la recherche dans le domaine des sciences naturelles et du génie, à l'exception des sciences de la santé.

Realistic computer graphics has become a core technology for many applications that are of importance to both industry and society at large. Some examples include design applications (e.g. interior- and industrial design), medical applications (e.g. surgical training simulators), education (e.g. learning software), heritage projects (virtual museums), as well as entertainment (e.g. special effects for movies, computer games).

Although much progress has been made on realistic computer graphics in the context of entertainment, the methods developed for this purpose emphasize manual interaction and artistic control to fine-tune the resulting images. This is undesirable in most other applications where
the computer generated images need to quantifiably represent existing real-world objects. To tackle this issue, several subproblems need to be addressed. First, physical models of real-world objects have to be acquired through imaging and other measurement techniques. Second, captured real world objects and phenomena need to be analyzed, and computational models need to be extracted for their behavior. Finally, algorithms need to be developed that are capable of using realistic, physically accurate models in rendering processes.

Following these long-term goals, the tasks for this application period include the following subproblems:

- Automatic methods for measuring objects with complex optical   properties will be developed. This includes new sensing technology for acquiring the geometry of object with difficult materials (such
  as translucent or highly specular objects), the processing of the geometry, and the acquisition of the material properties themselves.

- Imaging methods for dynamic phenomena such as fluid flow and fire will be developed. The measured data will allow for a systematic analysis of these phenomena, and the development of computational models that can be used in simulations.

- Efficient, high-quality rendering algorithms for the acquired models will be devised. A particular focus of this work will be seamless, high-quality level-of-detail control for both the geometry and its appearance based on measured information.

Heidrich, W. (Wolfgang)

REFEREE SUGGESTIONS / EXAMINATEURS SUGGÉRÉS

BY THE APPLICANT PAR LE CANDIDAT	Area(s) of expertise Domaine(s) d'expertise	BY THE EVALUATION GROUP PAR LE GROUPE D'ÉVALUATION
A Kutulakos (Kiriakos) Computer Science Univ. Toronto 10 King's College Road Totonto, ON, CANADA M5S3G4 kyros@cs.toronto.edu 1 (416) 946-8045	computer vision, computer graphics, object scanning	**1** PIN / NIP Lang.
B Fiume (Eugene) Computer Science Univ. Toronto 10 King's College Road Totonto, ON, CANADA M5S3G4 elf@dgp.toronto.edu 1 (416) 978-5472	computer graphics, imaging	**2** PIN / NIP Lang.
C Gooch (Bruce) Computer Science Univ. Victoria PO Box 3055, STN CSC Victoria, BC, CANADA V8W3P6 BruceGooch@gmail.com 1 (250) 472-5758	computer graphics, imaging	**3** PIN / NIP Lang.
D Raskar (Ramesh) Media Lab MIT 20 Ames St Cambridge, MA, UNITED STATES 02139 raskar@media.mit.edu 1 (617) 258-5079	computer graphics, vision, imaging	**4** PIN / NIP Lang.
E Gross (Markus) Computer Science ETH Zurich IFW D28.1, Haldeneggsteig 4 / Weinbergstrasse Zurich, SWITZERLAND grossm@inf.ethz.ch 41 (44) 6327114	graphics, imaging, vision	**5** PIN / NIP Lang.

EG / GE	1st Reviewer / 1er évaluateur	PIN / NIP
	2nd Reviewer / 2e évaluateur	PIN / NIP

Form / Formulaire 180 (2009 W)

Journal Articles

A1 **G. Wetzstein**, W. Heidrich, D. Luebke: *Optical Image Processing Using Light Modulation Displays*. Computer Graphics Forum, page (10 pages), 2009. (in print).

A2 **A. Ghosh**, W. Heidrich, **S. Achutha**, **M. O'Toole**: *A Basis Illumination Approach to BRDF Measurement*. International Journal on Computer Vision, page (15 pages), 2009. (in print).

A3 **B. Atcheson**, W. Heidrich, **I. Ihrke**: *An evaluation of optical flow algorithms for background oriented schlieren imaging*. Experiments in Fluids, 46(3):467–476, March 2009.

A4 **B. Atcheson**, **I. Ihrke**, W. Heidrich, A. Tevs, **D. Bradley**, M. Magnor, H.-P. Seidel: *Time-resolved 3D Capture of Non-Stationary Gas Flows*. ACM Transactions on Graphics (Proc. SIGGRAPH ASIA), 27(4):(9 pages), December 2008.

A5 **D. Bradley**, **T. Popa**, A. Sheffer, W. Heidrich, T. Boubekeur: *Markerless Garment Capture*. ACM Transactions on Graphics (Proc. SIGGRAPH), 27(3):Article 99 (9 pages), July 2008.

A6 **M. Trentacoste**, **H. Seetzen**, W. Heidrich, L. Whitehead, G. Ward: *Photometric Image Processing for High Dynamic Range Displays*. Journal of Visual Communication and Image Representation, 18(5):439–451, October 2007.

A7 **A. Rempel**, **M. Trentacoste**, **H. Seetzen**, **D. Young**, W. Heidrich, L. Whitehead, G. Ward: *Ldr2Hdr: On-the-fly Reverse Tone Mapping of Legacy Video and Photographs*. ACM Transactions on Graphics (Proc. SIGGRAPH), 26(3):Acticle 39 (6 pages), July 2007.

A8 R. Corbett, **K. van den Doel**, **J. Lloyd**, W. Heidrich: *TimbreFields — 3D Interactive Sound Models for Real-Time Audio*. Presence – Teleoperators and Virtual Environments, 16(6):643–654, December 2007.

A9 W. Heidrich: *Computing the Barycentric Coordinates of a Projected Point*. Journal of Graphics Tools, 10(3):9–12, 2005.

A10 **H. Seetzen**, W. Heidrich, W. Stuerzlinger, G. Ward, L. Whitehead, **M. Trentacoste**, **A. Ghosh**, A. Vorozcovs: *High Dynamic Range Display Systems*. In *ACM Transactions on Graphics (Proc. SIGGRAPH)*, pages 760–768. ACM, August 2004.

A11 P.-P. Vázquez, M. Feixas, M. Sbert, W. Heidrich: *Automatic View Selection Using Viewpoint Entropy and its Application to Image-Based Modelling*. Computer Graphics Forum, 22(4):689–700, November 2003.

A12 **X. Granier** and W. Heidrich: *A Simple Layered RGB BRDF Model*. Graphical Models, 65(4):171–184, July 2003.

A13 **M. Goesele**, **X. Granier**, W. Heidrich, H.-P. Seidel: *Accurate Light Source Acquisition and Rendering*. In *ACM Transactions on Graphics (Proc. SIGGRAPH)*, pages 621–630. ACM, July 2003.

A14 **K. Daubert**, W. Heidrich, **J. Kautz**, J.-M. Dischler, H.-P. Seidel: *Efficient Light Transport Using Precomputed Visibility*. IEEE Computer Graphics and Applications, 23(3):28–37, May/June 2003.

A15 **H. Lensch**, **J. Kautz**, **M. Goesele**, W. Heidrich, H.-P. Seidel: *Image-Based Reconstruction of Spatial Appearance and Geometric Detail*. ACM Transactions on Graphics, 22(2):234–257, April 2003.

Books and Book Chapters

B1 T. Akenine-Möller and W. Heidrich (eds.): Rendering Techniques 2006 (Proc. Eurographics Symposium on Rendering). Eurographics Association, June 2006. 443 pages.

B2 W. Heidrich and R. Balakrishnan (eds.): Proc. of Graphics Interface, 2004. A K Peters, June 2004. 279 pages.

Fully Reviewed Conference Papers

C1 **A. Rempel**, **R. Mantiuk**, W. Heidrich, Hiroe Li: *Video Viewing Preferences for HDR Displays Under Varying Ambient Illumination*. In *Proc. Applied Perception in Graphics and Visualization*, page 8 pages, 2009. in print.

C2 **R. Mantiuk**, **A. Rempel**, W. Heidrich: *Display Considerations for Night and Low-Illumination Viewing*. In *Proc. Applied Perception in Graphics and Visualization*, page 8 pages, 2009. in print.

C3 **D. Bradley**, **B. Atcheson**, **I. Ihrke**, W. Heidrich: *Synchronization and Rolling Shutter Compensation for Consumer Video Camera Arrays*. In *Proc. ProCams*, page 8 pages, 2009. **(Best paper award, second prize)**.

C4 R. Mantiuk, **R. Mantiuk**, A. Tomaszewska, W. Heidrich: *Color Correction for Tone Mapping*. In *Computer Graphics Forum (Proc. Eurographics)*, page 10 pages, 2009.

C5 T. Popa, Q. Zhou, **D. Bradley**, V. Kraevoy, H. Fu, A. Sheffer, W. Heidrich: *Wrinkling Captured Garments Using Space-Time Data-Driven Deformation*. In *Computer Graphics Forum (Proc. Eurographics)*, page 9 pages, 2009.

C6 **D. Bradley**, T. Boubekeur, W. Heidrich: *Accurate Multi-View Reconstruction Using Robust Binocular Stereo and Surface Meshing*. In *Proc. Conference on Computer Vision and Pattern Recognition (CVPR)*, page 8 pages, 2008.

C7 **A. Ghosh**, **S. Achutha**, W. Heidrich, **M. O'Toole**: *BRDF Acquisition with Basis Illumination*. In *Proc. International Conference on Computer Vision (ICCV)*, page 8 pages, 2007. **Oral presentation, Marr Prize Honorable Mention**.

C8 **H. Seetzen**, S. Makki, H. Ip, T. Wan, V. Kwong, G. Ward, W. Heidrich, L. Whitehead: *Self-Calibrating Wide Color Gamut High Dynamic Range Display*. In *Electronic Imaging*, page Paper 36 (9 pages), 2007.

C9 **T. Boubekeur**, W. Heidrich, X. Granier, C. Schlick: *Volume-Surface Trees*. In *Computer Graphics Forum (Proc. Eurographics)*, pages 399–406, 2006. (**Winner of the Günter Enderle Award and the Best Student Paper Award**).

C10 **A. Ghosh** and W. Heidrich: *Correlated Visibilty Sampling for Direct Illumination*. In *The Visual Computer (Proc. Pacific Graphics)*, pages 693–701, 2006.

C11 **A. Ghosh**, A. Doucet, W. Heidrich: *Sequential Sampling of Environment Maps*. In *Proc. Eurographics Symposium on Rendering*, pages 115–126, 2006.

C12 **B. Trifonov**, **D. Bradley**, W. Heidrich: *Tomographic Reconstruction of Transparent Objects*. In *Proc. Eurographics Symposium on Rendering*, pages 51–60, 2006.

C13 **H. Seetzen**, H. Li, L. Ye, W. Heidrich, L. Whitehead, G. Ward: *Observations of Luminance, Contrast, and Amplitude Resolution of Displays*. In *Society for Information Display (SID) Digest*, pages 1229–1233, 2006.

C14 **A. Ghosh**, **M. Trentacoste**, **H. Seetzen**, W. Heidrich: *Real Illumination from Virtual Environments*. In *Proc. Eurographics Symposium on Rendering*, pages 243–252, June 2005.

C15 **D. Burke**, **A. Ghosh**, W. Heidrich: *Bidirectional Importance Sampling for Direct Illumination*. In *Proc. Eurographics Symposium on Rendering*, pages 147–156, June 2005.

C16 **A. Ghosh**, **M. Trentacoste**, W. Heidrich: *Volume Rendering for High Dynamic Range Displays*. In *Proc. Volume Graphics 2005*, pages 91–98, June 2005.

C17 **S. Wang** and W. Heidrich: *The Design of an Inexpensive Very High Resolution Scan Camera System*. In *Computer Graphics Forum (Proc. of Eurographics)*, pages 441–450, September 2004.

C18 **R. Tam** and W. Heidrich: *Computing Polygonal Surfaces From Unions of Balls*. In *Computer Graphics International*, pages 86–92, June 2004.

C19 **H. Kück** and W. Heidrich: *Shape from Contours and Multiple Stereo*. In *Canadian Conference on Computer and Robot Vision*, pages 76–83, May 2004.

C20 **S. Wang** and W. Heidrich: *UBC ScanCam: An Inexpensive 122 Million Pixel Scan Camera*. In *IS&T/SPIE Symposium on Electronic Imaging*, pages 421–430, January 2004.

C21 **R. Tam** and W. Heidrich: *Shape Simplification Based on the Medial Axis Transform*. In *IEEE Visualization*, pages 481–488, October 2003.

C22 **X. Granier**, **M. Goesele**, W. Heidrich, H.-P. Seidel: *Interactive Visualization of Complex Real-World Light Sources*. In *Pacific Graphics*, pages 59–66, October 2003.

C23 **Y. Liu** and W. Heidrich: *Interactive 3D Model Acquisition and Registration*. In *Pacific Graphics*, pages 115–122, October 2003.

C24 **D. Pritchard** and W. Heidrich: *Cloth Motion Capture*. In *Computer Graphics Forum (Proc. of Eurographics)*, pages 263–271, September 2003.