

```

RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformPartialRevCubic( result, VM::toInt( state, 2 ) );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
fastFourierTransformVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->fastFourierTransform( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
maxAmplitudeVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->maxAmplitude( result, VM::toInt( state, 2 ), VM::toInt( state, 3 ), VM::toInt( state, 4 ) );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

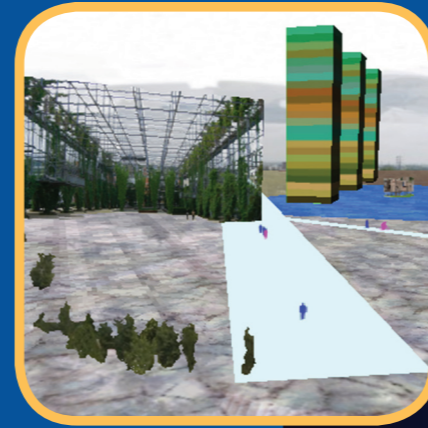
int
translateToMatchVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<const FCurveUniformSamples> other( FCurveUniformSamplesVM::toConst( state, 2 ) );
float scale, offset;
int translate = curve->translateToMatch( other, scale, offset );
VM::push( state, translate );
VM::push( state, scale );
VM::push( state, offset );
return 3;
}

CLASS RevOrdering
class RevOrdering
{
public:
bool operator() ( float a, float b ) const
{
return ( a < b );
}
};

class HaarWavletOrdering
{
public:
/*--- methods ---*/
HaarWavletOrdering( const FCurveUniformSamples::Container& wavelerCoefficients )
: _wavelerCoefficients( wavelerCoefficients )
{
if ( _wavelerMultiplier.size() == wavelerCoefficients.size() )
{
return;
}
_wavelerMultiplier.resize( wavelerCoefficients.size() );
uint increment;
for ( increment=1; increment < _wavelerMultiplier.size()-1; increment<<=1 )
{
uint wavelerIdx;
for ( wavelerIdx=0; wavelerIdx < _wavelerMultiplier.size(); wavelerIdx += increment )
{
if ( increment == 1 )

```

Graphics Interface 2009



```

( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->resampleLinear( result, VM::toInt( state, 2 ) );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformFwdHaarVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformFwdHaar( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformRevHaarVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformRevHaar( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformPartialRevHaarVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformPartialRevHaar( result, VM::toInt( state, 2 ) );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformFwdLinearVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformFwdLinear( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformRevLinearVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformRevLinear( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformPartialRevLinearVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformPartialRevLinear( result, VM::toInt( state, 2 ) );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformFwdCubicVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformFwdCubic( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

int
wavelerTransformRevCubicVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformRevCubic( result );
FCurveUniformSamplesVM::push( state, result );
return 1;
}

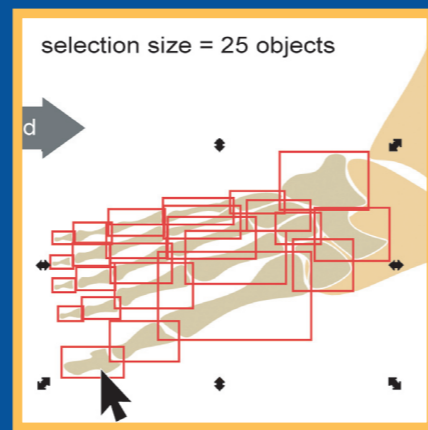
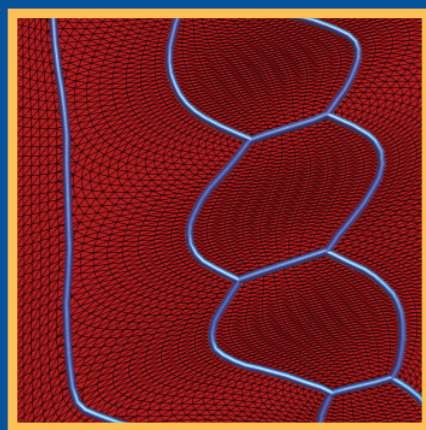
int
wavelerTransformPartialRevCubicVM
( VMState* state )
{
RCP<const FCurveUniformSamples> curve( FCurveUniformSamplesVM::toConst( state, 1 ) );
RCP<FCurveUniformSamples> result;
curve->wavelerTransformPartialRevCubic( result, VM::toInt( state, 2 ) );
FCurveUniformSamplesVM::push( state, result );
return 1;
}
}

```

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Graphics Interface 2009

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Canadian Human-Computer
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Dialogue Humaine Machine
(CHCCS/SCDHM)



```

wavelerMultiplier[wavelerIdx] = 1;
}
else
{
_wavelerMultiplier[wavelerIdx] += 2;
}
TRACE( "C << i << ", " << _wavelerMultiplier[i] << " );
}

bool operator() ( uint a, uint b ) const
{
return ( a < b );
}
}

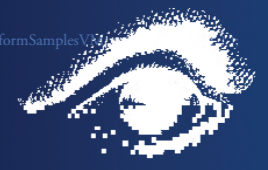
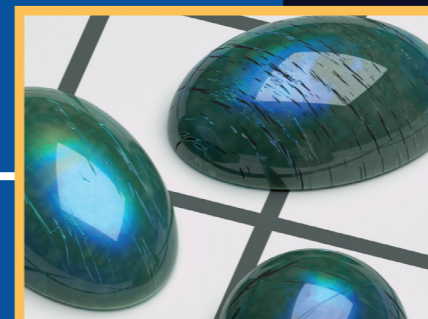
```



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Separability of Spatial Manipulations in Multi-touch Interfaces; Miguel A. Nacenta, Patrick Baudisch, Hrvoje Benko, Andy Wilson (Page 175)

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TOP TO BOTTOM ON FRONT:

Heart Rate Control of Exercise Video Games; Tadeusz Stach, T.C. Nicholas Graham, Jeffrey Yim, Ryan E. Rhodes (Page 125)

MR Tent: A Place for Co-Constructing Mixed Realities in Urban Planning; Valérie Maquil, Markus Sareika, Dieter Schmalstieg, Ina Wagner (Page 211)

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BELOW JOINT:

Rendering the Effect of Labradoescence; Andrea Weidlich, Alexander Wilkie (Page 79)

Author Index

Agarwala, Aseem : 111
Agrawala, Maneesh : 111, 119
Ammi, Mehdi : 203
Archambault, Daniel : 87
Balakrishnan, Ravin : 207
Barrett, William : 23
Barsky, Brian A. : 39
Baudisch, Patrick : 167, 175
Benko, Hrvoje : 175
Booth, Kellogg S. : 231
Bourdot, Patrick : 203
Brown, Steven : 23
Castellucci, Steven J. : 223
Chu, Gerry : 207
Cohen, Elaine : 31
Cohen, Michael F. : 111
Colburn, Alex : 111
Criminisi, Antonio : 47
Cuccuru, Gianmauro : 15
Curless, Brian : 111
Cutler, Barbara : 63
Davis, Randall : 157
Dawson, Jessica Q. : 231
DeRose, Tony : 119
Duchowski, Andrew T. : 141
Durand, Frédo : 215
Eoff, Brian David : 149
Fedorovskaya, Elena : 183, 191
Fernquist, Jennifer : 133
Findlater, Leah : 231
Gauthier, Mathieu : 1
Gobbetti, Enrico : 15
Gooch, Amy A. : 55
Graham, T.C. Nicholas : 125
Gramopadhye, Anand K. : 141
Grossman, Tovi : 167
Hammond, Tracy : 149, 157
Hazelton, Thomas W. : 133
Hinckley, Ken : 167
Imamiya, Atsumi : 199
Johnson, David E. : 31
Kajino, Manabu : 199
Kin, Kenrick : 119
Kosloff, Todd J. : 39
Long, Jeremy : 55
Low, Kok-Lim : 7
Lu, The-Kiet : 7
MacKenzie, I. Scott : 223
MacLean, Karon E. : 133
Maquil, Valérie : 211
Marton, Fabio : 15
McCrae, James : 95
Morse, Bryan : 23
Moscovich, Tomer : 207
Nacenta, Miguel A. : 175
Natapov, Daniel : 223
Neustaedter, Carman : 183, 191
Omata, Masaki : 199
Pajarola, Renato : 15
Paquette, Eric : 103
Paris, Sylvain : 215
Parker, Steven G. : 71
Pegoraro, Vincent : 71
Picon, Flavien : 203
Pintus, Ruggero : 15
Poirier, Martin : 103
Poulin, Pierre : 1
Rhodes, Ryan E. : 125
Rother, Carsten : 47
Salesin, David : 111
Sareika, Markus : 211
Schmalstieg, Dieter : 211
Schott, Mathias : 71
Shesh, Amit : 47
Shoemaker, Garth : 231
Simard, Jean : 203
Singh, Karan : 95
Smyth, Gavin : 47
Stach, Tadeusz : 125
Su, Sara L. : 215
Swerdfeger, Bradley A. : 133
Tao, Michael W. : 39
Vembar, Deepak : 141
Wagner, Ina : 211
Washburn, Carl : 141
Weidlich, Andrea : 79
Wilkie, Alexander : 79
Wilson, Andy : 175
Yapo, Theodore C. : 63
Yim, Jeffrey : 125
Zheng, Jianmin : 7
Zheng, Ke Colin : 111

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Edited by

Amy Gooch

Melanie Tory



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Contents

President’s Welcoming Letter.....	vi
Preface	vii
Organization.....	viii
Program Committee.....	viii
Reviewers.....	ix
Michael A. J. Sweeney Award 2009	x
Alain Fournier Award 2008: Samuel Hasinoff.....	xi
Achievement Award 2009: Przemyslaw Prusinkiewicz	xii
Invited Speaker: Vidya Setlur.....	xiii
Invited Speaker: David Luebke.....	xiv

Papers

Session 1: Geometry Processing

Preserving Sharp Edges in Geometry Images	1
Mathieu Gauthier, Pierre Poulin	
Fast Visualization of Complex 3D Models Using Displacement Mapping.....	7
The-Kiet Lu, Kok-Lim Low, Jianmin Zheng	

Session2: Surfaces and Meshes

Fast Low-Memory Streaming MLS Reconstruction of Point-Sampled Surfaces	15
Gianmauro Cuccuru, Enrico Gobbetti, Fabio Marton, Renato Pajarola, Ruggero Pintus	
Interactive Part Selection for Mesh and Point Models using Hierarchical Graph-Cut Partitioning	23
Steven Brown, Bryan Morse, William Barrett	
Computing Surface Offsets and Bisectors Using a Sampled Constraint Solver.....	31
David E. Johnson, Elaine Cohen	

Session 3: Image Editing: Depth, Focus, and Balance

Depth of Field Postprocessing For Layered Scenes Using Constant-Time Rectangle Spreading.....	39
Todd J. Kosloff, Michael W. Tao, Brian A. Barsky	
3D-aware Image Editing for Out of Bounds Photography.....	47
Amit Shesh, Antonio Criminisi, Carsten Rother, Gavin Smyth	
One-Click White Balance using Human Skin Reflectance.....	55
Jeremy Long, Amy A. Gooch	

Session 4: Rendering: Moonbeams, Mist, and Iridescent Gems

Rendering Lunar Eclipses.....	63
Theodore C. Yap, Barbara Cutler	
An Analytical Approach to Single Scattering for Anisotropic Media and Light Distributions.....	71
Vincent Pegoraro, Mathias Schott, Steven G. Parker	

Rendering the Effect of Labradoescence.....	79
Andrea Weidlich, Alexander Wilkie	
Session 5: Graphs, Paths, and Rigs	
Structural Differences Between Two Graphs through Hierarchies	87
Daniel Archambault	
Sketch-Based Path Design	95
James McCrae, Karan Singh	
Rig Retargeting for 3D Animation	103
Martin Poirier, Eric Paquette	
Session 6: Best Student Papers	
Parallax Photography: Creating 3D Cinematic Effects from Stills	111
Ke Colin Zheng, Alex Colburn, Aseem Agarwala, Maneesh Agrawala, David Salesin, Brian Curless, Michael F. Cohen	
Determining the Benefits of Direct-Touch, Bimanual, and Multifinger Input on a Multitouch Workstation	119
Kenrick Kin, Maneesh Agrawala, Tony DeRose	
Session 7: Haptics and Novel Interaction Techniques	
Heart Rate Control of Exercise Video Games	125
Tadeusz Stach, T.C. Nicholas Graham, Jeffrey Yim, Ryan E. Rhodes	
Exploring Melodic Variance in Rhythmic Haptic Stimulus Design	133
Bradley A. Swerdfeger, Jennifer Fernquist, Thomas W. Hazelton, Karon E. MacLean	
Improving Simulated Borescope Inspection with Constrained Camera Motion and Haptic Feedback	141
Deepak Vembar, Andrew T. Duchowski, Anand K. Gramopadhye, Carl Washburn	
Session 8: Pen and Touch Interfaces	
Who Dotted That ‘i’? : Context Free User Differentiation through Pressure and Tilt Pen Data	149
Brian David Eoff, Tracy Hammond	
Recognizing Interspersed Sketches Quickly	157
Tracy A. Hammond, Randall Davis	
Handle Flags: Efficient and Flexible Selections for Inking Applications.....	167
Tovi Grossman, Patrick Baudisch, Ken Hinckley	
Separability of Spatial Manipulations in Multi-touch Interfaces.....	175
Miguel A. Nacenta, Patrick Baudisch, Hrvoje Benko, Andy Wilson	
Session 9: Contextual Design	
Presenting Identity in a Virtual World through Avatar Appearances.....	183
Carman Neustaedter, Elena Fedorovskaya	
Understanding and Improving Flow in Digital Photo Ecosystems	191
Carman Neustaedter, Elena Fedorovskaya	
Session 10: HCI Notes	
A Multi-level Pressure-Sensing Two-Handed Interface with Finger-Mounted Pressure Sensors.....	199
Masaki Omata, Manabu Kajino, Atsumi Imamiya	
Potential Field Approach for Haptic Selection.....	203
Jean Simard, Mehdi Ammi, Flavien Picon, Patrick Bourdot	
Haptic Conviction Widgets	207
Gerry Chu, Tomer Moscovich, Ravin Balakrishnan	

MR Tent: A Place for Co-Constructing Mixed Realities in Urban Planning	211
Valérie Maquil, Markus Sareika, Dieter Schmalstieg, Ina Wagner	
Session 11: Pointing, Selection, and Text Input	
QuickSelect: History-Based Selection Expansion.....	215
Sara L. Su, Sylvain Paris, Frédo Durand	
ISO 9241-9 Evaluation of Video Game Controllers	223
Daniel Natapov, Steven J. Castellucci, I. Scott MacKenzie	
Mid-Air Text Input Techniques for Very Large Wall Displays	231
Garth Shoemaker, Leah Findlater, Jessica Q. Dawson, Kellogg S. Booth	
Author Index.....	Inside Back Cover

President's Welcoming Letter



Canadian Human Computer Communications Society /
Société Canadienne du Dialogue Humaine Machine

Bill Cowan
David R. Cheriton School
of Computer Science
University of Waterloo, Canada

The Canadian Human-Computer Communications Society (CHCCS) / Société Canadienne du Dialogue Humaine Machine (SCDHM) is a Special Interest Group within the Canadian Information Processing Society. It is a non-profit organization with the goal of advancing education and research in computer graphics, visualization and human-computer interaction.

Each year CHCCS/SCDHM sponsors Graphics Interface, the oldest regularly scheduled conference in interactive computer graphics. Most years it is co-located and co-organized with several other conferences: this year the AI/GI/CRV 2009 conference, encompassing Artificial Intelligence, Graphics Interface, and Computer and Robotic Vision, is being held at the University of British Columbia – Okanagan in Kelowna, British Columbia. Graphics Interface promises to be an exciting event, with a selection of high quality papers in computer graphics, visualization and human-computer interaction.

Complementing the annual conference, CHCCS/SCDHM sponsors four awards: the annual Michael A. J. Sweeney Awards for the best student papers presented at the conference; the annual Alain Fournier Ph.D. Thesis Award, presented for the best Ph.D. dissertation awarded in Canada during the previous year in an area of research supported by CHCCS/SCDH; the annual CHCCS/SCDH Achievement Award, presented to a Canadian who has made substantial research contributions to computer graphics, visualization or human-computer interaction; and the CHCCS/SCDH Service Award, presented to a Canadian who has rendered substantial service contributions to the society or to the research community. Each year the Awards Committee receives nominations and selects a winner of the Achievement Award and, from time to time, a winner of the Service Award. At this year's conference we will present an Achievement Award to Przemyslaw Prusinkiewicz, an internationally recognized researcher well known to the Graphics Interface community. I wish to thank the awards committee for their efforts this year:

- Richard Bartels, University of Waterloo (emeritus), Chair,
- Kellogg Booth, The University of British Columbia, and
- Eugene Fiume, University of Toronto

The Annual General Meeting of CHCCS/SCDHM is held every year during the Graphics Interface conference, to review the previous year's activities and elect the executive committee. Current members of the executive committee are:

- Bill Cowan, University of Waterloo, President,
- Kellogg S. Booth, The University of British Columbia, Past President,
- Pierre Poulin, Université de Montréal, Vice President,
- Stephen Mann, University of Waterloo, Treasurer,
- Ted Kirkpatrick, Simon Fraser University, Editor-in-Chief, and
- James Stewart, Queen's University, Webmaster

All Graphics Interface attendees are invited to attend the Annual General Meeting, or to contact any member of the executive committee about CHCCS/SCDHM.

On behalf of the society, and of all those who have worked to put on this year's conference, I extend a warm welcome to all the attendees of AI/GI/CRV 2009. I also wish to thank Amy Gooch and Melanie Tory, the co-chairs of the program committee, along with all of the committee members and referees who created the conference program. And most important I wish to thank all the authors who submitted their research. Without their commitment there would be no conference.

Preface

A Message from the Program Cochairs

Amy Gooch
Department of Computer Science
University of Victoria, Canada

Melanie Tory
Department of Computer Science
University of Victoria, Canada

Welcome to Graphics Interface 2009. This annual conference, now in its 35th year, is devoted to computer graphics, human-computer interaction, and visualization. Graphics Interface occupies a unique niche among conferences in that it seeks to both combine and bridge research topics in and across these areas. Beginning in 1969 as the “Canadian Man-Computer Communications Seminar” (CMCCS), it is the oldest regularly scheduled computer graphics and human-computer interaction conference. This year, Graphics Interface was held 25-27 May 2009 in Kelowna, British Columbia.

We received a total of 77 submissions, of which we accepted 28 regular papers and 4 notes (4-page papers). The final program is balanced between HCI and computer graphics, with both tracks seeing similar acceptance rates: 44% for the HCI track, and 41% for the graphics track.

Twenty-three international experts served on the program committee, solicited and managed reviews from a wide body of other experts and helped to select a very high quality set of papers for this year’s conference. Most papers received four reviews, two of which were from program committee members. We particularly thank the program committee for their expertise and effort in ensuring both high standards and interesting breadth in this year’s technical program. We also thank the many external reviewers for their help in this endeavor.

We would also like to extend our appreciation to this year’s invited speakers, who are both outstanding leaders in their respective fields: Vidya Setlur, Nokia Research Center, and David Luebke, NVIDIA Research. Additionally, Amy would like to thank David Mould for covering the Program Committee Meeting and all that it entails in her absence.

Lastly, we wish to thank several people whose efforts were indispensable in making Graphics Interface 2009 happen: William Cowan, Kellogg S. Booth, James Stewart, Torsten Möller, Arthur Kirkpatrick, Jeremy Long, and Meghan Haley.

For further information about the conference series we invite you to visit the web site, <http://www.graphicsinterface.org>.

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Mark Drew	Ahmad Nasri	
Andrew Duchowski	Carman Neustaedter	
Marc Ebner	Tao Ni	
Elmar Eisemann	Greg Nichols	
Mario Enriquez	Chris North	
Parisa Eslambolchilar	Ian Oakley	
Leah Findlater	Marc Olano	
Tim Foley	Gustavo Patow	
Mike Fraser	Isenberg Petra	
Christian Fuchs	Lane Phillips	
Abhijeet Ghosh	Peter Pirulli	
Saul Greenberg	Tiberiu Popa	
Cindy Grimm	Pierre Poulin	
Erwin de Groot	Gonzalo Ramos	
Gaël Guennebaud	Robert Rauschenberger	
Sean Gustafson	Adrian Reetz	

Michael A. J. Sweeney Award 2009



Canadian Human Computer Communications Society /
Société Canadienne du Dialogue Humaine Machine

The CHCCS/SCDHM honours the memory of Michael A. J. Sweeney through an annual award to the best student paper(s) presented at each year's Graphics Interface conference. The winning paper(s) selected by the program committee are chosen from among the papers accepted for the conference for which one or more student authors are presenting the paper.

Best Student Paper 2009

In Memory
Michael A. J. Sweeney, 1951-1995

Graphics 2009 Award Winner

"Parallax Photography: Creating 3D Cinematic Effects from Stills"
by Ke Zheng, Alex Colburn, Aseem Agarwala, Maneesh Agrawala,
Brian Curless, David Salesin, Michael Cohen.

BIOGRAPHIES

Colin Zheng received a Ph.D. in Computer Science & Engineering from the University of Washington in the fall of 2008. His areas of research are computer graphics, computer vision, and computational imaging.

Alex Colburn is a graduate student in the University of Washington's Computer Science & Engineering department where he is working on computer graphics & computer vision. Prior to graduate school, Alex spent 10 years at Microsoft Research.

Aseem Agarwala is a senior research scientist at Adobe Systems, Inc. and an affiliate assistant professor at the University of Washington. He completed his Ph.D. in 2006 at the University of Washington, and his B.S. and M.Eng. at MIT in 1999.

Maneesh Agrawala is an Assistant Professor in Electrical Engineering and Computer Science at the University of California, Berkeley. He works on visualization, computer graphics and human computer interaction.

Brian Curless received the B.S. degree in Electrical Engineering at the University of Texas at Austin in 1988 and the Ph.D. degree from Stanford University in 1997. He is an associate professor in the Department of Computer Science & Engineering at the University of Washington.

David Salesin is a Professor of Computer Science & Engineering at the University of Washington, and a Senior Principal Scientist at Adobe Systems, where he leads the Creative Technologies Lab. He received the 2000 ACM SIGGRAPH Computer Graphics Achievement Award for pioneering the field of non-photorealistic rendering.

Michael F. Cohen is a Principal Researcher at Microsoft Research. Michael received the 1998 SIGGRAPH Computer Graphics Achievement Award for his contributions to the Radiosity method for image synthesis.

HCI 2009 Award Winner

"Determining the Benefits of Direct-Touch, Bimanual, and Multifinger Input on a Multitouch Workstation" by Kenrick Kin, Maneesh Agrawala, Tony DeRose.

BIOGRAPHIES

Kenrick Kin received a B.S.E. in Computer Science from Princeton University. He is currently pursuing a Ph.D. in Computer Science at the University of California, Berkeley (UC Berkeley), where he is working with Professor Maneesh Agrawala on multitouch interaction techniques and is part of the Computer Graphics Group. He also works part time at Pixar Animation Studios.

Maneesh Agrawala is an Assistant Professor in Electrical Engineering and Computer Science at the University of California, Berkeley. He works on visualization, computer graphics and human computer interaction.

Tony DeRose is currently a Senior Scientist at Pixar Animation Studios. He received a B.S. in Physics from the University of California, Davis, and a Ph.D. in Computer Science from UC Berkeley. From 1986 to 1995 Dr. DeRose was a Professor of Computer Science and Engineering at the University of Washington. In 1998, he was a major contributor to the Oscar winning short film "Geri's game", in 1999 he received the ACM SIGGRAPH Computer Graphics Achievement Award, and in 2006 he received a Scientific and Technical Academy Award for his work on surface representations.

Alain Fournier Award 2008



Canadian Human Computer Communications Society /
Société Canadienne du Dialogue Humaine Machine

On August 14th, 2000, Dr. Alain Fournier passed away. He was a leading international figure in computer graphics, and a strong and frequent contributor to the Graphics Interface conference. His insights, enthusiasm, wisdom, vast knowledge, humour, and genuine friendship touched everyone he met.

The “Alain Fournier Memorial Fund” was created to celebrate his life, to commemorate his accomplishments, and to honour his memory. It rewards an exceptional computer graphics Ph.D. thesis defended in a Canadian University over the past year. The winning thesis is selected through a juried process by a selection committee consisting of accomplished researchers in computer graphics.

For more information about the “Alain Fournier Memorial Fund”, and information about donation, please visit <http://www.cs.ubc.ca/~fournier>.



Samuel Hasinoff

University of Toronto, Canada

CHCCS/SCDHM Alain Fournier
Award Recipient 2008

This year’s recipient of the Alain Fournier Ph.D. Thesis Annual Award is Samuel Hasinoff. His 2008 thesis, “Variable Aperture Photography”, completed at the University of Toronto under the supervision of Professor Kyros Kutulakos, makes several significant contributions to the field of computational photography. By combining multiple captures of the same scene with varying exposure, focus, and aperture settings – all taken by a single, conventional digital camera – Sam’s techniques are able to

- create a pixel-resolution depth map that works even for complicated images,
- allow the photographer to defer the application of several camera settings (e.g., depth-of-field) until post-production,
- reproduce an exposure with a synthesized depth-of-field in less time than a conventional single exposure, and
- given time and depth-of-field constraints, find an optimal sequence of exposures.

The thesis is well-organized and well-written. Sam’s dedication to thoroughness and attention to both mathematical and experimental details are exemplary. In the coming years, this work is likely to have significant impact on camera design and photography in general.

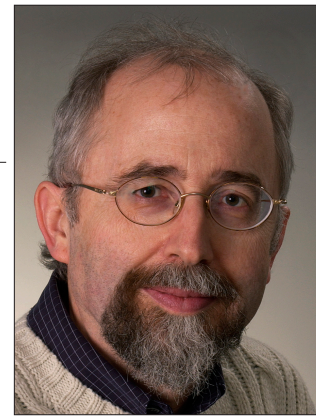
Sam completed his B.Sc. at the University of British Columbia in 2000 and his M.Sc. at the University of Toronto in 2002 (also under Professor Kutulakos). He has received numerous scholarships from NSERC and other organizations and is currently an NSERC Postdoctoral Fellow at MIT.

Achievement Award 2009



Canadian Human Computer Communications Society /
Soci t  Canadienne du Dialogue Humaine Machine

The CHCCS/SCDHM Achievement Award is presented periodically to a Canadian researcher who has made a substantial contribution to the fields of computer graphics, visualization, or human-computer interaction. Awards are recommended by the CHCCS/SCDHM Awards Committee, based on nominations received from the research community. The 2009 members of the Awards Committee are Richard Bartels, Eugene Fiume, and Kellogg Booth.



Przemyslaw Prusinkiewicz

University of Calgary, Canada

CHCCS/SCDHM Achievement
Award Recipient 2009

Professor Prusinkiewicz is Professor of Computer Science at the University of Calgary and is the head and founder of the Biological Modeling and Visualization research group at that institution. Professor Prusinkiewicz received his M.S. (1974) and Ph.D. (1978) in Computer Science from the Technical University of Warsaw. He held Assistant Professorships at the Technical University of Warsaw and at the University of Science and Technology of Algiers before joining the University of Regina in 1982. He was appointed to his current position at the University of Calgary in 1991.

While at the University of Regina, Professor Prusinkiewicz took an active interest in the formalism of L-systems developed by Aristid Lindenmayer, a theoretical biologist. An L-system is a type of formal grammar that is invoked iteratively on an initial configuration of elements and is characterized by the simultaneous parallel use of all applicable production rules at each iteration to successively transform the configuration. Lindenmayer had proposed L-systems as a model for studying the growth of organisms. Professor Prusinkiewicz had the insight that the formal configurations of symbols produced by the grammar could be interpreted with graphical elements depicting features of plants. His first result on this topic, part of a list of over 150 papers authored or co-authored by Professor Prusinkiewicz, appeared in 1986 as the paper "Graphical Applications of L-Systems" delivered to our very own Graphics Interface Conference of that year. His work has also been presented in the classical and influential books, *The Algorithmic Beauty of Plants* and *Lindenmayer Systems, Fractals, and Plants*.

The pioneering work by Professor Prusinkiewicz has led to the visual richness of nature we see in Hollywood's computer-generated imagery. But his work has not been restricted to the visual alone. Professor Prusinkiewicz and his students have collaborated with scientists around the world to explore the use of L-systems in music generation, develop models of fracture formation, build software environments for geometric and biological modeling (LEGO, GeneVis, Virtual Laboratory, L-Studio and the L+C language), analyze processes of biochemical transport, and study the relationships between plants and their insect pests as well as the impact of microclimates on the growth of plant communities. His current research is focused on computational models of development that link plant genetics to their macroscopic forms.

Professor Prusinkiewicz has received numerous awards for his innovative research, including the 1997 ACM SIGGRAPH Computer Graphics Achievement Award. The Canadian Human Computer Communications Society is pleased to add our achievement award to his list of honors and recognitions.

Invited Speaker

Semantic Graphics for More Effective Visual Communication

Vidya Setlur

Nokia Research Center, USA



ABSTRACT

Computers are becoming faster, smaller and more interconnected, creating a shift in their primary function from computation to communication. This trend is exemplified by ubiquitous devices such as mobile phones with cameras, personal digital assistants with video, and information displays in automobiles. As communication devices and viewing situations become more plentiful, we need imagery that facilitates visual communication across a wide range of display devices. In addition, producing effective and expressive visual content currently requires considerable artistic skill and can consume days. There is a growing need to develop new techniques and user interfaces that enhance visual communication, while making it fast and easy to generate compelling content. New algorithms in semantic graphics, i.e. combining concepts and methods from visual art, perceptual psychology, information processing, and cognitive science, help facilitate users in creating, understanding and interpreting computer imagery. In this talk, Vidya Setlur will present the usage of semantic graphics for various information visualization goals.

BIOGRAPHY

Vidya Setlur is a research scientist in the User Interfaces Group, at Nokia Research Center, Palo Alto. She is also an adjunct professor at Carnegie Mellon University, Silicon Valley. After graduating from Northwestern University in 2005 with a Ph.D. in computer graphics, Vidya initially started her stint with Nokia at their lab in Dallas, but later moved to Palo Alto in 2006. Her work at Nokia involves researching novel rendering algorithms particularly targeted for mobile computational devices for enhancing visual communication.

Invited Speaker

Graphics Hardware & GPU Computing: Past, Present, and Future

David Luebke

Manager, NVIDIA Research
NVIDIA Corporation, USA



ABSTRACT

Modern GPUs have emerged as the world's most successful parallel architecture. GPUs provide a level of massively parallel computation that was once the preserve of supercomputers like the MasPar and Connection Machine. For example, NVIDIA's GeForce GTX 280 is a fully programmable, massively multithreaded chip with up to 240 cores, 30,720 threads and capable of performing up to a trillion operations per second. The raw computational horsepower of these chips has expanded their reach well beyond graphics. Today's GPUs not only render video game frames, they also accelerate physics computations, video transcoding, image processing, astrophysics, protein folding, seismic exploration, computational finance, radioastronomy - the list goes on and on. Enabled by platforms like the CUDA architecture, which provides a scalable programming model, researchers across science and engineering are accelerating applications in their discipline by up to two orders of magnitude. These success stories, and the tremendous scientific and market opportunities they open up, imply a new and diverse set of workloads that in turn carry implications for the evolution of future GPU architectures.

In this talk I will discuss the evolution of GPUs from fixed-function graphics accelerators to general-purpose massively parallel processors. I will briefly motivate GPU computing and explore the transition it represents in massively parallel computing: from the domain of supercomputers to that of commodity "manycore" hardware available to all. I will discuss the goals, implications, and key abstractions of the CUDA architecture. Finally I will close with a discussion of future workloads in games, high-performance computing, and consumer applications, and their implications for future GPU architectures.

BIOGRAPHY

David Luebke helped found NVIDIA Research in 2006 after eight years on the faculty of the University of Virginia. Luebke received his Ph.D. under Fred Brooks at the University of North Carolina in 1998. His principal research interests are GPU computing and real-time computer graphics. Luebke's honors include the NVIDIA Distinguished Inventor award, the NSF CAREER and DOE Early Career PI awards, and the ACM Symposium on Interactive 3D Graphics "Test of Time Award". Dr. Luebke has co-authored a book, a SIGGRAPH Electronic Theater piece, a major museum exhibit visited by over 110,000 people, and dozens of papers, articles, chapters, and patents.

For more information, please visit: <http://luebke.us/>