Curriculum Vitae

Zachary Justin Wartell
Assistant Professor
Department of Computer Science
University of North Carolina at Charlotte

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1 Education

Degree	Year	University	Field
Ph.D.	2001	Georgia Institute of Technology	Computer Science
B.S.	1994	Georgia Institute of Technology	Computer Science

2 Professional Experience

Title	Organization	Years
Assistant Professor	Department of Computer Science University of North Carolina at Charlotte.	2005-present
Visiting Assistant Professor	Department of Computer Science University of North Carolina at Charlotte.	2004-2005
Research Scientist II	College of Computing, Georgia Institute of Technology.	2002-2004
Research Scientist I	College of Computing, Georgia Institute of Technology.	2001-2002
Graduate Research Assistant	College of Computing, Georgia Institute of Technology.	1996-2001
Graduate Intern	Virtual Reality Lab, Naval Research Laboratory.	1997 (Summer)
Member Technical Staff	Human Interface Technology Center, NCR/AT&T.	1994-1996

3 Licenses and Certifications

None.

4 Publications

Note: The following conventions are common in Computer Science in the U.S. For student authored papers, student authors are listed first as a group and advisors/PI's are listed second as a group. Within each group the lead author/advisor goes first. In publications where I was advisor the details of my role are found in separate endnotes in each subsection. For advisors/PIs authored papers, the advisors names go first as a group and students go second as a group. In all citations below, advisor names are underlined.

4.1 Peer Reviewed Journal Publications

[1] Thomas Butkiewicz, Douglas A. Shoemaker, Remco Chang, **Zachary Wartell***, Ross K. Meentemeyer, and William Ribarsky (2010). "Alleviating the Modifiable Areal Unit Problem within Probe-Based Geo-spatial Analyses". To appear in EuroVis 2010 / Computer Graphics Forum, vol. 29, num. 3, June 2010.
[www]   *(tier 1)*

[2] Thomas Butkiewicz, Wenwen Dou, **Zachary Wartell***, William Ribarsky, Remco Chang (2008). "Multi-Focused Geospatial Analysis Using Probes". IEEE Transactions on Visualization and Computer Graphics (TVCG)/ InfoVis 2008, vol. 14, no 6. pp. 1165-1172, Nov/Dec, 2008.
[www , IEEE DOI]   *(acceptance rate 26%, tier 1)*

[3] Thomas Butkiewicz, Remco Chang, **Zachary Wartell***, William Ribarsky (2008). "Visual Analysis and Semantic Exploration of Urban LIDAR Change Detection," Computer Graphics Forum (EuroVis 2008), vol. 27, num. 3, September 2008.
[www, CGF DOI]   *(acceptance rate 31%; tier 1)*

[4] Remco Chang, Thomas Butkiewicz, Caroline Ziemkiewicz, **Zachary Wartell****, Nancy Pollard, William Ribarsky (2008). "Legible Simplification of Textured Urban Models," IEEE Computer Graphics and Applications (CG&A) Special Issue on Procedural Urban Modeling, pp. 27-36, May/June 2008.
[www , IEEE DOI]   *(tier 2)*

[5] **Zachary Wartell**, Larry F. Hodges, William Ribarsky (2002). "An Analytic Comparison of Alpha-False Eye Separation, Image Scaling and Image Shifting in Stereoscopic Displays," IEEE Transactions on Visualization and Computer Graphics, Volume 8, Number 2, pp. 129-143, April-June 2002.
[www , IEEE DOI]   *(tier 1)*

[6] Bastian Leibe, Thad Starner, William Ribarsky, **Zachary Wartell**, David Krum, Justin Weeks, Bradley Singletary, and Larry Hodges (2000). "Toward Spontaneous Interaction with the Perceptive Workbench." IEEE Computer Graphics and Applications, pp. 2-12, November/December 2000.
[www , IEEE DOI]   *(tier 2)*

  * I am thesis advisor of lead author (Butkiewicz).
 ** I am lead project advisor.

4.2 Peer Reviewed Conference Publications

[7] Amy C. Ulinski, **Zachary Wartell**[†], Paula Goolkasian, Evan A. Suma, and Larry F. Hodges (2009), "Selection performance based on classes of bimanual actions," 3D User Interfaces, 2009. 3DUI 2009. IEEE Symposium on, vol., no., pp.51-58, March 14-15 2009.
[www, IEEE DOI]   *(26.5% acceptance rate; tier 2)*

[8] Amy Ulinski, Catherine Zanbaka, **Zachary Wartell**[†], Paula Goolkasian, Larry F. Hodges (2007). Two Handed Selection Techniques for Volumetric Data. IEEE Symposium on 3D User Interfaces 2007. Charlotte, North Carolina, pg 107-114. March 10-11, 2007.
[www, IEEE DOI] *(23% acceptance rate; tier 2)*

[9] **Zachary Wartell**, Eunjung Kang, Tony Wasilewski, William Ribarsky, and Nickolas Faust (2003). Rendering Vector Data over Global, Multiresolution 3D Terrain. Eurographics-IEEE Visualization Symposium 2003, pp. 213-222, 2003.
[www] *(48% acceptance rate; tier 2)*

[10] **Zachary Wartell** and Larry Hodges and William Ribarsky (2001). "Characterizing Image Fusion Techniques in Stereoscopic HTDs." Proceedings of Graphics Interface 2001, Ottawa, Canada, pp. 223-232, June 2001.
[www] *(48% acceptance rate; tier 2)*

[11] Bastian Leibe, Thad Starner, William Ribarksy, **Zachary Wartell**, David Krum, Brad Singletary, Larry F. Hodges (2000). "The Perceptive Workbench: Towards Spontaneous and Natural Interaction in Semi-Immersive Virtual Environments." Proceedings of IEEE Virtual Reality 2000 Conference. March 18-22, New Brunswick, NJ: IEEE Computer Society Press, 2000.
Received Best Paper Award.
[www, IEEE DOI] *(33% acceptance rate; tier 1)*

[12] **Zachary Wartell**, Larry F. Hodges, William Ribarsky (1999). "Balancing Fusion, Image Depth, and Distortion in Stereoscopic Head-Tracked Displays." SIGGRAPH 99 Conference Proceedings, Annual Conference Series. ACM SIGGRAPH, Addison Wesley, pp. 351-357, August 1999.
[www, ACM DOI] *(16.3% acceptance rate; tier 1)*

[13] **Zachary Wartell**, William Ribarsky, Larry Hodges (1999). "Efficient Ray Intersection for Visualization and Navigation of Global Terrain using Spheroidal Height-Augmented Quadtrees." VisSym '99, Joint EUROGRAPHICS - IEEE TCCG Symposium on Visualization, in Vienna, Austria, May 26-28, 1999.
[www] *(47% acceptance rate, tier 2)*

[14] **Zachary Wartell**, William Ribarsky, Larry Hodges. "Third-Person Navigation of Whole-Planet Terrain in a Head-Tracked Stereoscopic Environment." Proceedings of IEEE Virtual Reality '99 Conference, March 13-17, Houston, Texas: IEEE Computer Society Press, 1999, pp. 141-148.
[www, IEEE DOI] *(33% acceptance rate; tier 1)*

[15] Jim Durbin, J. Edward Swan II, Brad Colbert, John Crowe, Rob King, Tony King, Chris Scannell, **Zachary Wartell**, Terry Welsh (1998). "Battlefield Visualization on the Responsive Workbench." Proceedings IEEE Visualization '98, October 18-23, Research Triangle Park, North Carolina: IEEE Computer Society Press, 1998, pp.463-6, 568.
[IEEE DOI] *(42.4% acceptance rate; tier 2)*

† I am thesis co-advisor of lead author Amy Ulinski with Larry F. Hodges.

4.3 Peer Reviewed Extended Abstracts/Short Papers

[16] E. Suma, S. Clark, S. Finkelstein, and **Z. Wartell**[‡], "Leveraging Change Blindness for Walking in Virtual Environments," *2010 IEEE VR Workshop on Perceptual Illusions in Virtual Environments*, pp. 10.
[www] *(tier 1)*

[17] Thomas Butkiewicz, Dong Hyun Jeong, **Zachary Wartell**[‡‡], William Ribarsky, and Remco Chang. "Hierarchical Multi-touch Selection Techniques for Collaborative Geospatial Analysis". SPIE Volume 7346: Visual Analytics for Homeland Defense and Security, Orlando, FL United States, April 13-17 2009. Edited by Tolone, William J.; Ribarsky, William, pp. 73460D-73460D-9 (2009).
[www] *(tier 3)*

[18] Evan Suma, Samantha Finkelstein, Seth Clark, **Zachary Wartell**[‡]. "An Approach to Redirected Walking by Modifying Virtual World Geometry". PIVE 2009. Proceedings of IEEE VR 2009 Workshop on Perceptual Illusions in Virtual Environments, Lafayette, Louisiana, USA, pp. 16-18, March 15 2009.
[www]   *(tier 1)*

[19] Thomas Butkiewicz, Remco Chang, **Zachary Wartell**[‡‡], William Ribarsky. "Visual Analysis for Live LIDAR Battlefield Change Detection," Defense and Security 2008: Special Sessions on Food Safety, Visual Analytics, Resource Restricted Embedded and Sensor Networks, and 3D Imaging and Display, Orlando, Florida, USA, M. S. Kim, K. Chao, W. J. Tolone, W. Ribarsky, S. I. Balandin, B. Javidi, S.-I Tu, Eds., Proc. of SPIE Vol. 6983, pp. 69830B.1-69830B.10, 17-18 March 2008.
[www , SPIE DOI]   *(tier 3)*

[20] Thomas Butkiewicz, Remco Chang, **Zachary Wartell**[‡‡], William Ribarsky, "Analyzing Sampled Terrain Volumetrically with Regard to Error and Geologic Variation", Proc. SPIE Visualization and Data Analysis 2007, San Jose, CA. 2007.
[www , SPIE DOI]   *(acceptance rate %50, tier 3)*

[21] Remco Chang and Thomas Butkiewicz and Caroline Ziemkiewicz and **Zachary Wartell**[‡‡‡] and Nancy Pollard and William Ribarsky, Hierarchical simplification of city models to maintain urban legibility, SIGGRAPH '06: ACM SIGGRAPH 2006 Sketches, 2006, Boston, Massachusetts pg130.
[www , ACM DOI]   *(tier 1)*

[22] William Ribarsky, **Zachary Wartell**[‡‡‡‡], and Nickolas Faust (2003). "Precision Markup Modeling and Display in a Global Geospatial Environment," SPIE 17th International Conference on Aerospace/Defense Sensing, Simulation, and Controls (2003).
[SPIE DOI]   *(tier 3)*

[23] W. Ribarsky, C.D. Shaw, **Z.J. Wartell**[‡‡‡‡], and N.L. Faust, "Building the visual Earth," *Radar Sensor Technology and Data Visualization*, N.L. Faust, J.L. Kurtz, and R. Trebits, Eds., SPIE, 2002, pp. 228-239.
[SPIE DOI]   *(tier 3)*

[24] Jim Durbin, S.J. Julier, B. Colbert, J. Crowe, B. Doyle, R. King, T. King, C. Scannell, **Z.J. Wartell**, T. Welsh (1998). "Making information overload work: the Dragon software system on a virtual reality responsive workbench." Digitization of the Battlespace III, April 1998. Proceedings of the SPIE - The International Society for Optical Engineering, vol.3393, pp.96-107.
[SPIE DOI]   *(tier 3)*

[25] Mark A Tarlton, P. N. Tarlton, E.J. Lee, **Zachary Wartell** (1995). "Objects, Modeling and Media: A Framework for Interactive 3D Applications." AT&T Middleware Day and Software Symposium. October 24-26, 1995 Holmdel, New Jersey.   *(tier 3)*

   ‡   I am project advisor.
  ‡‡   I am thesis advisor of lead author (Butkiewicz).
 ‡‡‡   I am lead project advisor.
‡‡‡‡   I am project co-advisor & lead software developer

4.4   Peer Reviewed Posters

[26] Evan Suma, Seth Clark, Samantha Finkelstein, and **Zachary Wartell***, "Exploiting Change Blindness to Expand Walkable Space in a Virtual Environment," IEEE Virtual Reality 2010. Poster Paper. Virtual Reality Conference (VR), 2010 IEEE, Boston, MA, USA, 20-24 March 2010, pg 305 – 306.
[www , IEEE DOI]   *(tier 1)*

[27] Amy Ulinski and **Zachary Wartell**** and Larry F. Hodges. "Bimanual task division preferences for volume selection," In Proceedings of the 2007 ACM Symposium on Virtual Reality Software and Technology (Newport Beach, California, November 05 - 07, 2007). S. N. Spencer, Ed. VRST '07.

ACM, New York, NY, 217-218, 2007.
[ACM DOI]   *(tier 1)*

[28] Ernst Houtgast, Onno Pfeiffer, **Zachary Wartell*****, William Ribarsky, and Frits Post (2005),
``Navigation and interaction in a multi-scale stereoscopic environment,'' Poster Paper in Proc. IEEE
Virtual Reality 2005 (B. Fröhlich, S. Julier, and H. Takemura, eds.), pp. 275--276, IEEE Computer
Society Press, March 2005.
[www , IEEE DOI]   *(tier 1)*

   * I am project advisor.
  ** I am thesis co-advisor of lead author Amy Ulinski with Larry F. Hodges.
*** I am lead project advisor.

4.5 Peer Reviewed Book Chapters

[29] **Zachary Wartell**, Ernst Houtgast, Onno Pfeiffer, Chris D Shaw, William Ribarsky, and Frits Post,
Interaction Volume Management in a Multi-scale Virtual Environment, Advances in Information &
Intelligent Systems, SCI 251, Z.W. Ras and W. Ribarsky Editors, Springer-Verlag, Berlin, 2009, pp.
327-349.
[www]

[30] Thomas Butkiewicz, Remco Chang, William Ribarsky, and **Zachary Wartell**[††]. "Visual Analysis of
Urban Terrain Dynamics." In "Understanding Dynamics of Geographic Domains", May Yuan,
Kathleen S. Hornsby. CRC Press/Taylor and Francis. 2007.
[manuscript figures]

[31] William Ribarsky, Nickolas Faust, **Zachary Wartell**[†††], Christopher Shaw, and Justin Jang. "Visual
Query of Time-Dependent 3D Weather in a Global Geospatial Environment," Mining Spatio-
Temporal Information Systems, R. Ladner, K. Shaw, and Mahdi Abdelguerfi, Editors, Kluwer,
Amsterdam, 2002.

   † I am lead project advisor and lead author.
  †† I am project co-advisor (Ribarsky 50%, Wartell 50%)
††† I am project co-advisor.

4.6 Patents Awarded
None

4.7 Manuscripts under Review

[32] Samantha L. Finkelstein, Andrea Nickel, Zachary J. Lipps, Tiffany Barnes, **Zachary Wartell**‡, Evan
A. Suma. *Astrojumper: Motivating Exercise with an Immersive Virtual Reality Exergame.*
Submitted to Presence: Teleoperators and Virtual Enviroments: MIT Press, March 2010.   *(tier 2)*

‡ I am project co-advisor (Barnes 40%, Wartell 40%, Suma 20%)

4.8 Patents under Review
None

4.9 Other Publications

[33] Zachary Wartell, "Stereoscopic Head-Tracked Displays: Analysis and Development of Display Algorithms," Ph.D. Dissertation, Georgia Institute of Technology, August 2001. [www]

5   Extramural Funding

This section lists grants on which I was investigator while at UNCC. Information on prior grants, pending proposals, and non-successful proposals over this period are available upon request.

5.1   Peer Reviewed National and International Grants

G1. Title of Grant: "Theory and Application of an Eye-Point Dependent Metric for Multi-resolution Terrain Models"
PI: Dr. William Ribarsky (lead), **Dr. Zachary Wartell**
Funding Agency: Department of the Army, US Army Research, Development and Engineering Command.
Purpose: Research
Amount Funded: $260,000 total
Funding Period: Summer 2005-Summer 2008

G2. Title of Grant: "Representations and Metrics for Time-Varying Terrain Surfaces"
PI: **Zachary Wartell** (lead), William Ribarsky
Funding Agency: Department of the Army, US Army Research, Development and Engineering Command.
Purpose: Research
Amount Funded: $260,000 total
Funding Period: Summer 2009-Summer 2012

G3. Title of Grant: "Collaboration with DHS Center for Excellence for Natural Disasters, Coast Infrastructure and Emergency Management"
Funding Institution: UNC Chapel Hill
Funding Agency: Department of Homeland Security
PI: Dr. William Ribarsky (lead), **Dr. Zachary Wartell**, Dr. Aidong Lu
Purpose: Research
Amount Funded: $91,430 per year, 2 years
Funding Period: Feb 1 2009 – Jan 30 2011

G4. Title of Grant: "Hierarchical Analysis and Modeling of Dynamic Interactions between Societal and Ecological Factors in the Charlotte Metropolitan Region"
Funding Agency: National Science Foundation
PI: (Lead) Ross Meentemeyer, Jean-Claude Thill, Martin Ribarsky
Co-Investigators: Victoria Bott, **Zachary Wartell**
Purpose: Research
Amount Funded: $286,033.36
Funding Period: 01/15/2010 - 01/14/2012

5.2   Peer Reviewed Industrial Grants

None

5.3   Peer Reviewed Regional Grants

G5. Title of Grant: "3D Modeling and Interactive Visualization of Urban Areas"
     PI: Dr. William Ribarsky (lead), **Dr. Zachary Wartell**, Dr. Jiyeong Lee
     Funding Agency: Charlotte-Mecklenburg GIS Department
     Purpose: Research
     Amount Funded: $50K total
     Funding Period: 1 year, Fall 06/Spring 07

G6. Title of Grant: "Virtual Charlotte: South End Planning Study"
     PI: Dr. Jose Gamez (lead), Dr. William Ribarsky, **Dr. Zachary Wartell**
     Funding Agency: Charlotte-Mecklenburg Planning Commission
     Purpose: Research
     Amount Funded: $20K total
     Funding Period: 1/2 year, Spring 07

G7. Title of Grant: "Renaissance Computing Institute Engagement Site in Charlotte, NC"
     PI: Dr. Jeff Michael (Lead), Dr. Ross Meentemeyer, Dr. Jean-Claude Thill, Dr. Bill Ribarsky
     Co-Investigators: **Dr. Zachary Wartell**, Dr. Brian Etherton, Dr. Srinivas Pulugurtha
     Funding Agency: UNC Chapel Hill
     Purpose: Research
     Amount Funded: $1,433,336
     Funding Period: 11/01/2007 – 6/30/2010

5.4   Peer Reviewed Institutional Grants
     None

5.5   Awards and Donations
     None

5.6   Other Grants
     None

6   Student Supervision

6.1   Doctoral Students Supervised

Thesis Advisees

1. Isaac Cho – thesis advisor
    <u>Spring 2008 – *present*</u>

2. William Brady Fulmer – thesis advisor
    <u>Fall 08 – Fall 09</u> – student dropped out of Ph.D. program

3. Thomas Butkiewicz – thesis advisor
    <u>Fall 06 – Spring 10</u>
    Dissertation: "Probe-Based Visual Analysis of Geospatial Simulations"

4. Amy Ulinski – thesis co-advisor (with Larry F. Hodges)
   Fall 05 – Fall 08
   Dissertation: "Taxonomy and Experimental Evaluation of Two-handed Selection Techniques for Volumetric Data"

Project Advisees

5. Remco Chang – project co-advisor
   "Legible Simplification of Textured Urban Models"

6. Evan Suma – project advisor
   "Re-directed Walking Technique Based on Change-Blindness"

6.2   Amy Ulinski Masters Students Supervised

1. Craig Tyler – thesis co-advisor with K.R. Subramanian
   Fall 06 – Spring 07
   Thesis: "GPU acceleration for global terrain rendering"
2. Ruhi Surve – ITCS 6880 Individual Study
   Fall 09
   Title: "Multi-touch Display Interfaces"
3. Priyank Jain – ITCS 6880 Individual Study
   Fall 09
   Title: "Interactive 3D Games"
4. Priyank Jain – GRA advisor
   Fall 09 – Spring 10
   Title: "Representations and Metrics for Time-Varying Terrain Surfaces"
5. Priyank Jain – ITCS 6880 Individual Study
   Spring 10
   Title: "Virtual Environments",
6. Chris Wykel – ITCS 6880 Individual Study
   Spring 10
   Title: "Probe User Interfaces for Geospatial Visualization",
7. Justin Babbs – GRA
   Summer 2006-Summer 2007
   Title: Charlotte-Mecklenburg Planning Commission
8. Subhir Rao – ITCS 6880 Individual Study
   Spring 06, Fall 06
   Title: "Improving VGIS Object Rendering"
9. Hunter Hale – GRA
   Spring 06
   Title: "Integrating 3D models of terrain and buildings into terrain visualization application"
10. Caroline Ziemkiewicz – GRA
    Spring 06
    Title: "Meteorological Visualization"
11. Sweta Kautia - ITCS 6880 Individual Study
    Summer 06, Fall 06
    Title: "Multi-Scale Interaction on Stereoscopic Displays"

12. Cynthia Zhang – GRA
    Fall 04, Spring 05
    Title: "Risk-based Geo-spatial Path Finding"
13. Jonathan Jackson - ITCS 6880 Individual Study
    Spring 2005
    Title: "Wireless Tracking of Tangible Objects for VR Interaction"
14. Robbie Foster – Individual Study
    Fall, Spring 2004
    Title: "Improving Paged Object Performance in VGIS"
15. Eunjung Kang – Individual Study
    Fall, Spring 2003
    Title: "Rendering Vector Data over global terrain"

6.3   Bachelors Students Supervised

1. Samantha Finkelstein – Undergraduate Research Project
   Fall 09 – *present*
   Title: "AstroJumper: A Virtual Reality Exercise Game"
2. Seth Clark – Undergraduate Research Project
   Spring 09 – Spring 10
   Title: "Redirected Walking in Virtual Environments"
3. Brady Fulmer – NSF REU
   Summer 2007
   Title: "Two-Handed Stereoscopic User Interfaces"
4. Tera Green – NSF REU
   Summer 2006
   Title: "Two-Handed Stereoscopic User Interfaces"
5. David Christensen – Senior Project
   Fall 06
   Title: "An Urban Planning Visualization Tool"
6. Brandon Bush – Individual Study
   Fall 2006
   Title: "Integrating UNCC Building Models into VGIS"
7. Ernst Houtgast – Foreign Exchange Program
   Summer 2004
   Title: "3D Interaction in a Multi-Scale, Stereoscopic Environment"
8. Onno Pfeiffer - Foreign Exchange Program
   Summer 2004
   Title: "3D Interaction in a Multi-Scale, Stereoscopic Environment"
9. Drew Griscom – Individual Study
   Summer 2002
   Title: "Improving Performance of Object Rendering the VGIS System"
10. Chris Lawrence - Individual Study
    Summer 2002
    Title: "Multi-threaded structure for OpenGL"

7 Teaching

7.1 Major Accomplishments

7.1.1 New Courses

ITSC 1712. Honors Introduction to Computer Science
First Taught: *delayed due to budget cuts*
Status: CCI Faculty approved Spring 09

Within the CCI Honors Committee, Dr. K.R. Subramanian and I lead development of the curriculum based on reviewing 1212 & 1215.

ITCS 6127/8127 Real-time Rendering Engines –
First Taught: Spring 2008.
I co-taught and developed this course with Dr. K.R. Subramanian. Students read roughly 25 papers and book excerpts. Students were graded on presentations of papers, 2 smaller projects and 1 term project.

ITCS 6128/8128 3D Display and Advanced Interfaces, –
First Taught: Spring 2006

I created this course. Students read roughly 20 papers and book excerpts. I put together 415 slides approximately 50% of which were newly developed. The other 50% were modifications of slides from my previous work and research in the field. Students contributed an additional 4 papers worth of slides (roughly 60 slides). Students were graded on class participation, a course project, and a written final exam.

7.1.2 Leadership on Existing Courses

ITCS 4120 and ITCS 6120/8120 Introduction to Computer Graphics
I have taken ownership of the introductory computer graphics courses in our department at the undergraduate and graduate levels. These graphics courses are key required courses in two of the department's specializations: visualization and games. Over the past five years, I have done significant development on the lecture material and student project material. The current course slide set includes 650 slides. I authored roughly 85% of them and re-wrote the remaining 15% based on Dr. Larry F. Hodges' course material. I use PowerPoint animations to help illustrate geometric concepts and the MathType Equation Editor for all equations. I personally developed numerous example programs along with automatically extracted skeleton code on which students' base their projects.

ITSC 6125/8125 Virtual Environments
Dr. Larry F. Hodges taught the course at UNCC for 7 years. Now that he has become Dean at Clemson University I have taken ownership of this course. Budget permitting, this course is up for rotation in the 2010 academic year.

7.2   Courses Taught

7.2.1   Graduate Courses

Course #	Course Name	Semester/Year	Average Enrollment
ITCS 6010	3D Display and Advanced Interfaces	Spring 06	4
ITCS 6120	Computer Graphics	Fall 07, Fall 09	13
ITCS 6127/8127	Real-time Rendering Engines	Spring 08	7
ITSC 8110	Introduction to Information Technology Research	Fall 08	32
ITSC 8699	Graduate Seminar	Fall 08, Spring 09	60

7.2.2   Undergraduate Courses

Course #	Course Name	Semester/Year	Average Enrollment
ITCS 4120/5120*	Introduction to Computer Graphics	Spring 05, Fall 05, Fall 06, Fall 07, Spring 06	12
ITCS 1214	Introduction to Computer Science I	Spring 08	18
ITCS 4121/5121*	Information Visualization	Spring 09	31
ITCS 2214	Data Structures	Spring 10	50
ITCS 2175	Logic and Algorithms	Spring 10	50

* 4xxx/5xxx courses are cross-listed and taken by both undergraduate and graduate students

7.2.3   Other Courses
None

8 Service and Outreach

8.1 Accomplishments

Below are several highlighted accomplishments that enhanced the exposure of the College of Computing and Informatics and UNC Charlotte.

- <u>IEEE Virtual Reality Conference 2007</u> - IEEE VR is the premier international conference on virtual reality. In 2007, it was held in Charlotte. I was local arrangements co-chair. I organized hotel accommodations, catering and meals, social events and presentation facilities. The College of Computing and Informatics hosted an evening event that brought all conference attendees to the College of Computing and Informatics laboratories for research demonstrations.
- <u>Visualization and the World 2008</u> – The Charlotte Visualization Center sponsored this two day symposium with world renowned invited speakers. I and all CCI VisCenter faculty and staff participated in the planning and organizing of this event.
- <u>Symposium on the Future of Visualization 2006</u> - The Charlotte Visualization Center sponsored this two day symposium with world renowned invited speakers. There were roughly 300 attendees. I and all CCI VisCenter faculty participated in the planning and organizing of this event.
- <u>VisCenter Outreach Demonstrations</u> – Over the past five years, my students and I have given roughly 10 demonstrations per year (50 total) to guests from academia, industry and government, prospective graduate students and school children for programs such as Explore UNCC and Girls are I.T. VisCenter demonstrations are particularly attractive due to their visual nature and their use of advanced virtual reality displays and multi-touch displays.

8.2 External Service

8.2.1 Invited Talks

1. RENCI Multi-Touch Table Urban Growth Simulation. Super Computing, November 14-20, 2009. *Invited demonstration.*
2. Emerging Issues Forum - *Changing Landscapes: Building the Good Growth State?* - February 9-10, 2009, Raleigh, NC. "An Urban Growth Simulation on RENCI Multi-touch Table". *Invited Demonstration.*
3. Visualization and the World 2008 – April 2008, Charlotte, NC. *Invited Talk.*
4. Charlotte GIS User Group – October 18, 2008. *Invited Talk.*
5. Symposium on the Future of Visualization 2006 – April 2006, Charlotte, NC. *Invited Talk*
6. GIS Day – CPCC Central Campus. November 15, 2006. GIS Day is a one-day event containing university, industry and government poster presentations. *Invited Participant*

8.2.2 Journal/Conference Reviewer

Conference:

- ACM CHI: 2010
- IEEE 3D UI: 2009
- IEEE VR: 2009, 2005, 2004, 2001
- IEEE Visualization: 2010, 2009, 2005, 2003

- EuroVis: 2009, 2008
- EUROGRAPHICS Workshop on Virtual Environments: 2008
- ACM Siggraph: 2007
- Eurographics Symposium on Rendering: 2006, 2003
- ACM VRST: 2001, 1998
- ACM UIST: 2000
- ACM Symposium on Interactive 3D Graphics: 1999

Journal:

- IEEE Transactions on Visualization and Computer Graphics: 2009, 2008, 2007, 2006, 2005, 2003, 2000
- IEEE Computer Graphics and Applications: 2009, 2003
- Graphical Models (Elsevier): 2009
- The Visual Computer Journal: November 1999

8.2.3   Program Committees

- IEEE VR 2007, Local Arrangements Co-Chair

8.2.4   Editorial Boards/Panels
None

8.2.5   Professional Affiliations/Memberships

1. IEEE Society member
2. ACM member

8.2.6   Community Service
None

8.3   Internal Service

8.3.1   University Committees
None

8.3.2   College Committees

1. College Honors Committee - 2009
2. College Honors Committee - 2008

8.3.3   Department Committees

1. Department Ph.D. Committee – 2009
2. Department Teaching Review Committee –2008
3. Department Teaching Review Committee – 2007
4. Department Facilities and Equipment Committee – 2006
5. VisCenter Seminar Organizer – 2006
6. Graduate Committee – 2004

    7.   Department Facilities and Equipment Committee – 2005

8.3.4   Ph.D. Dissertation/Master's Thesis/Baccalaureate (Honors) Committees

1. Dong Jeong, Ph.D. student, qualifier committee (Fall 08), proposal committee (Spring 09), thesis committee (Spring 10)
2. Evan Suma, Ph.D. student, proposal committee (Spring 09), thesis committee (Spring 10)
3. Remco Chang, Ph.D. student, qualifier committee (Fall 08), proposal committee (Spring 09), thesis committee (Fall 09)
4. Xiaoyu Wang, Ph.D. student, qualifier committee (Spring 09)

8.4   Other Service

Charlotte Visualization Center –

    Within the Charlotte Visualization Center I co-wrote the proposals, wrote the technical specifications, and oversaw the purchase and installation for $300K worth of equipment including a three screen Barco virtual reality display system, a custom 3x3 high-resolution tiled display, a custom multi-touch table, a Vicon camera-based tracking system with desktop stereoscopic display, a file server and several dozen graphics workstations. I have managed the VisCenter computer assignments and seating arrangements. I also co-managed the VisCenter seminar series for several semesters.

9 Leadership

In the realm of teaching, I have shown leadership in the creation of several courses including ITCS 6128 3D Displays and Advanced Interfaces, ITCS 6127 Real-time Rendering Engines and ITCS 1712 Honors Introduction to Computer Science. I have taken ownership of the introductory undergraduate and graduate computer graphics courses, ITCS 4120 and ITCS 6120, and developed a significant amount of lecture and project curriculum. These courses are core courses in two of the department's specialization tracks: visualization and computer games. I have also taken ownership of the 6125 Virtual Environments course after Dr. Larry F. Hodges left the department and I am combining his course material with my material from 6128.

In the realm of research, my work has appeared in tier 1 and 2 journals and conferences including IEEE InfoVis, IEEE VR, IEEE TVCG, IEEE CGA, ACM Siggraph, Computer Graphics Forum and IEEE 3D UI. I advised graduated Ph.D. student Tom Butkiewicz, co-advised graduated Ph.D. student Amy Ulinski and advised and co-published with graduated Ph.D. students Evan Suma and Remco Chang. This fall I will have 3 Ph.D. advisees. I co-advised one Master's thesis student, supervised 14 others and supervised 10 undergraduate research projects including several NSF REU students. In the past five years I have been an investigator on seven grants totaling $2.4M. An additional $900K grant starts this July. I am co-investigator on a pending $1.6M proposal and a PI on a $4K proposal. I am completing negotiations of a 9 month contract with Duke Energy and I am PI on a $500K proposal due in July. I participated in an additional seven unfunded proposals with total requested funds of $8.4M.

In the realm of internal service, I have played a significant role in the Charlotte Visualization Center. I co-wrote the proposals, wrote the technical specifications, and oversaw the purchase and installation of roughly $300K dollars worth of equipment including a three screen Barco virtual reality display system, a custom 3x3 high-resolution tiled display, a custom multi-touch table, a Vicon camera-based tracking system and desktop stereoscopic display, a file server and several dozen graphics workstations. This equipment is available to all VisCenter faculty and associated faculty and students and has been used by students in ITCS 6128, ITCS 6125, ITCS 4010/5010 (Serious Games Prototyping and Evaluation), multiple individual study courses and the College's NSF REU summer program. These advanced display systems are a key part of CCI outreach demonstrations to attract prospective students to the field of computing.

Within the department and college I have been on 9 committees. Of particular impact was the College Honors Committee in which we established the nascent CCI Honors Program and an honors version of the Introduction to Computer Science course. I and the VisCenter faculty also established the visualization track within the Computer Science department.

In the realm of external service, I was local arrangements co-chair of IEEE VR, the premier international conference on virtual reality, which was held in Charlotte in 2007. As part of this conference, attendees toured the CCI research laboratories including the VisCenter and the Future Computing Lab. This event brought significant international recognition to our college and our laboratories. Collectively the VisCenter faculty, staff and I twice held a two day symposiums on visualization--Visualization and the World in 2008 and Symposium on the Future of Visualization in 2006--which reached 300 attendees. Finally, I am a regular reviewer for various tier 1 and 2 conferences and journals.

10 Research Statement

My research spans 3D visualization and virtual reality. Much of it is driven by geo-spatial data which is a core element in weather prediction, urban planning and disaster management. Geo-spatial data is challenging because it is large, heterogeneous, multi-scale, and combines surface and volumetric geometry of high complexity. Many other areas that share similar characteristics, such as 3D medical data, may equally benefit from interactive visualization and VR.

In visualization, I developed a number of interaction techniques and rendering algorithms. I led the development of interactive methods to address the MAUP problem in geo-spatial statistics [1], methods for multi-focal spatial analysis [2] and methods for visual exploration of urban LIDAR change detection [3]. In computer graphics, I led the development of several algorithms for rendering and querying geo-spatial data including: algorithms for rendering large scale urban environments [4][21]; algorithms for rendering vector data on multi-resolution terrain [9], and algorithms for out-of-core ray intersection [13]. More recently I led the development of algorithms for terrain mesh analysis [3][19][20] and I am leading a project to develop hybrid volumetric + surface data structures for modeling terrain with uncertainty measures (grant [G2]).

In virtual reality, I developed a virtual travel technique for a multi-scale, global geo-spatial environment [14]. This requires virtual travel through 7 degrees-of-freedom--position, orientation and scale--in order to maintain optimal direct manipulation and stereoscopic viewing. I also derived and analyzed analytic equations that describe various distortions of the displayed, stereoscopic 3D image in head-tracked, but stationary displays such as the CAVE [5][12]. My experience with 7DOF travel techniques and the analysis of 3D image distortions allowed me to match the geometric requirements of virtual reality applications to the technique best suited for maintaining comfortably fusible stereoscopic images [10]. Later, colleagues and I expanded our geo-spatial VR application to render volumetric weather data. I led the development of a variety of 3D interaction techniques for exploring this volumetric data [28][29]. A key component of this work was generalizing my prior 7DOF travel techniques to maintain optimal direct manipulation and stereoscopic viewing conditions of the user's volume-of-interest.

Building on my work in volumetric data interaction, I and colleagues led the development and formal evaluation of two-handed, 3D selection techniques for volumetric data [7][8][27]. To narrow the experimental scope, this work was limited to monoscopic display and data sets viewable at a single scale. I'm currently leading an experiment on stereoscopic perception of volumetric data. This project will continue my work on semi-automated techniques for maintaining the user's volume-of-interest within the optimal working volume of a given display [29]. In a separate vein, I led a study on a novel re-directed walking technique with Ph.D. student Evan Suma. This project developed a novel re-directed walking technique based on change-blindness [16][18][26]. We just finished formal evaluation of this technique which will be submitted to IEEE VR 2011. This spring, I and Dr. Tiffany Barnes developed and evaluated a VR exercise game for autistic children. We completed evaluations with young adults; this work is in submission [32].

I led several non-VR, spatial input user interface projects. I led the development of multi-touch interface algorithms [20] and the development of a multi-touch urban growth simulation [2] (also featured at ACM Super Computing '09). This Spring, I led the development of a vision tracked laser pointer for the VisCenter tiled-display. I and colleagues are leading the development of multi-display interaction techniques that combine this tiled display interaction with our multi-touch display. This work will build on my experience combining off-the-shelf and custom spatial input technologies on the virtual workbench [6][11].

11 Teaching Statement

Excellent teaching requires mastery of the material, clear and organized presentation, clear course expectations, a balance between your audience's experience level and appropriate standards, and finally flexibility and creativity.

Mastering core computer science material was function of my undergraduate and graduate education. Certainly, however, I have had to review material and learn new material when I've developed new curriculum such as ITCS 6127 Real-time Rendering Engines or taught courses such as ITCS 4121 Information Visualization that stretched beyond my original expertise.

Regarding clarity and organization of the presentation, I use modern presentation tools to capture and maintain student attention. This is particularly true in courses such as introductory computer graphics where the material involves 2D and 3D geometric computation. Having taken primary responsibility for this course, I invested significant effort in updating and developing the lecture slides to make them visually appealing to students. I revamped nearly every PowerPoint slide I inherited improving mathematical notation using MathType and I generated a huge number of new slides including many PowerPoint animations to illustrate concepts such as aliasing, coordinate systems, transformations and hierarchical coordinate systems. My undergraduates in particular seemed to expect and need more visually appealing presentations. The current slide set includes over 600 slides counting animated frames. Regarding clarity of assignment requirements, I invested significant effort developing supplementary instructional material for programming projects including creating written guides for using various tools, such as SVN and various compilers and IDEs. I also created a mini-guide on how to master a new programming language because UNCC students do not thrive using the "Here's the recommended C++ book. You know how to program already, so go read it" approach that works for seniors elsewhere.

Equally important when teaching is finding the right balance between adjusting to your audience's experience level and abilities while maintaining appropriate academic standards. Within computer graphics, for example, I separated the undergraduate and graduate courses, breaking the original cross-listed 4120/5120 into separate 4120 and 6120 courses. I added a week and a-half lecture on systems programming concepts such as pointers and explicit memory allocation in C++ and allowed the undergraduates to use application programming languages such as Java in the course. I also experimented with making mini-programming assignments to force students to compile and run working code and then answer questions about its real-time behavior. This reinforced concepts such as the effects of double buffering.

This leads to a teacher's need for flexibility and creativity. While my one semester experiment with mini-programming assignments improved student retention, the overhead of the additional assignments reduced coverage of core material too greatly. Therefore, I dropped these tutorial assignments. Teaching requires the flexibility and willingness to develop and try new approaches and the willingness to throw away the created material if experience shows that it does not improve student performance or that it has unintended negative consequences. Often, this process can inform improvements in other aspects of the course curriculum. For example, during my first computer graphics semester I developed an illustrated slide set to better explain the 3D geometry of radiosity computations. In subsequent semesters, however, I dropped that material as too mathematically sophisticated, but having learned that students responded better to higher quality illustrations, I expanded my illustrations on basic concepts such as coordinate system transformations and aliasing.