

# What Can We Gain from Transdisciplinary Visualization Courses?

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## Abstract

*Transdisciplinary education means going even further in the collaboration with other disciplines than multidisciplinary and interdisciplinary education do. Transdisciplinary education attempts to search for new insights and views that emerge by balancing the importance of each participating discipline. Because most visualization problems are posted by disciplines other than Computer Science and because good solutions to visualization problems span knowledge over different disciplines, we often find interest from students outside the CS area in our visualization courses. This panel will discuss transdisciplinary (as well as interdisciplinary and multidisciplinary) visualization courses from four different viewpoints of the four panellists: What do multidisciplinary, interdisciplinary and transdisciplinary education mean in practical terms for an educator of a visualization course? What benefits does an applied research institute expect from graduates that have experience in interdisciplinary or transdisciplinary versus unidisciplinary collaboration? Will there be enough interest from non-CS students to attend such visualization courses?*

Categories and subject descriptors: I.3.8 [Computer Graphics]: Applications; K.3.2 [Computers and Education]: Computer and Information Science Education

Additional Key Words and Phrases: Education in Visualization and Visual Analytics.

## 1. Raising Awareness for Transdisciplinary Visualization Courses

Transdisciplinary education means going even further in the collaboration with other disciplines than multidisciplinary and interdisciplinary education do [Ros92]. Multidisciplinary education looks at teaching from the view point of different disciplines – usually sequentially and independently. Interdisciplinary education additionally emphasizes the intersection of disciplines, usually mixing students from various disciplines in one course and looking at a shared problem space to find a solution. Transdisciplinary education attempts to search for new insights and views that emerge by balancing the importance of each participating discipline and therefore demands ([Ros92]; [Sto06], [DF05], [DSH08]):

- taking up sufficient time to establish a common ground between participants,
- overcoming interpersonal processes, alternate disciplinary views, unrealistic expectations between participants,
- expanding on collaboration and communication skills required for knowledge building,
- collaborating between educators from participating disciplines.

And what do we gain for all that extra work that it takes to expand a course from disciplinary into transdisciplinary mode? What is specifically in there for Computer Science students? Gerhard Fischer [DF05] states: “*If the world of working and living relies on collaboration, creativity, definition and framing of complex problems – and if it requires dealing with uncertainty, change, and intelligence that is distributed across cultures, disciplines, and tools – then [university] programs should foster transdisciplinary competencies and mindsets that prepare students for having meaningful and productive lives in such a world.*” Computer science students would thus learn to collaborate with other disciplines, get ready to tackle complex, real life problems, and might end up with a new view of the opportunities and limitations of their own field.

The choice to introduce interdisciplinarity (or multidisciplinary, or transdisciplinary) in a CS curriculum through visualization courses comes about naturally because of the multidisciplinary nature of visualization problems: Most of the visualization problems solved and published since the advent of “Visualization in Scientific Computing” in 1987 [MDB87] have been posted by disciplines other

than computer science. With the expansion into Visual Analytics, we are involving even more disciplines in the solution part, and harnessing new problem domains. Building bridges between disciplines to derive at the most expressive and effective visual presentations has been an inherent part of doing visualization in the past, including Renaissance Teams or knowledge-based visualization systems.

Transdisciplinary education, transdisciplinary research and transdisciplinary science are gaining more and more attention (e.g. [NRC03]; [NSF03]). Can research and solving complex problems of the real world truly expect benefits from graduates of transdisciplinary visualization courses? Can universities overcome interdepartmental obstacles to teach such courses? Do disciplines other than Computer Science value transdisciplinary education? What can education committees and educator programs do in future to support transdisciplinary visualization courses? A panel of experts will make their statements and answer questions.

## 2. Panel Discussion

The panellists will discuss their experience with different levels of multidisciplinary/interdisciplinary/transdisciplinary education in visualization and/or visual analytics. In particular they will address:

**Dieter Fellner**, professor of Computer Science at the Technical University of Darmstadt and leading a group of about 200 full-time researchers at Fraunhofer Institute for Computer Graphics (IGD) in Darmstadt, who deal with all aspects of Computer Graphics and its applications. For their customers they perform about 300 studies, research projects and product prototype developments per year: *“What benefits does an applied research institute expect from graduates that have experience in interdisciplinary or transdisciplinary collaboration?”*

**Alan Chalmers**, professor of Computer Graphics, recently joined the Digital Laboratory at Warwick University, UK. Coming from a computer science department (at University of Bristol) he recently moved into the multi-disciplinary environment of the Warwick Digital Lab: *“How will your teaching change in the new environment? Can your university overcome interdepartmental obstacles to teach interdisciplinary or transdisciplinary courses?”*

**Holly Rushmeier**, on the faculty of Computer Science at Yale, recently organized a successful workshop on “Visualization Education for Non-Technical Majors” at IEEE Visualization 2006. She is part of a team at Yale developing an initiative on “Computing and the Arts” that includes new undergraduate major and multiple graduate research threads in the area of computing and art, art history, music, drama and architecture: *“Will there be interest from non-CS students to attend transdisciplinary visualization courses?”* *“What should be the balance between teaching disciplinary fundamentals and transdisciplinary education?”*

**Gitta Domik**, on the faculty of the Institute of Computer Science at the University of Paderborn and a member of the ACM Siggraph Education committee, maintains a website on “Visualization Education” ([www.upb.de/cs/vis](http://www.upb.de/cs/vis)). She is currently (fall/winter 2007/2008) taking a sabbatical at the Center for LifeLong Learning & Design (L3D) at the University of Colorado at Boulder to learn about interdisciplinary and transdisciplinary collaboration through their work on social creativity: *“What do multidisciplinary, interdisciplinary and transdisciplinary education mean for an educator in practical terms? What methods and strategies can educators use, what obstacles need to be overcome?”*

A question to each of the panel members will be: *“What possibilities does your school offer for multidisciplinary/interdisciplinary/transdisciplinary education? Is there need/room for change in the future?”*

Panel results will be summarized on the Visualization website <http://www.upb.de/cs/vis>.

## 3. Biographies of Panellists

### Alan Chalmers

[www2.warwick.ac.uk/fac/sci/wmg/about/people/profiles/achalmers/](http://www2.warwick.ac.uk/fac/sci/wmg/about/people/profiles/achalmers/)

Alan Chalmers is Professor of Visualisation at the new Warwick Digital Laboratory at the University of Warwick. Previously he was a professor at the Computer Science Department at the University of Bristol. He received his PhD from the University of Bristol in 1991, his MSc (with distinction) from Rhodes University, SA, in 1984. His current research interests are very realistic graphics, visual perception, archaeological site reconstructions, presence in virtual environments, parallel processing. He has served on many committees and held/holds several distinguished appointments, including:

Afrigraph Honourary President 2006-Present  
ACM SIGGRAPH Vice President 1999-2002

Euorgraphics Executive Committee member 2003-2006

Co-Chair of Eurographics Symposia Series: Graphics & Cultural Heritage

Visual Information Engineering Executive Member 1999-2005

Technical Director of ArchLight 2001-2004.

### Gitta Domik

[www.upb.de/cs/domik](http://www.upb.de/cs/domik)

Gitta Domik is professor of Computer Science at the University of Paderborn, Germany. Her research and teaching interests are in visualization, computer graphics, and image processing. Before joining the University of Paderborn she was a research assistant professor at the Department of Computer Science at the University of Colorado at Boulder (USA). Her previous professional life was spent with positions at the Center for Astrophysics and Space Astronomy at the University of Colorado (1987-1990), at Vexcel Corporation in Boulder (1985-1987), and the

Institute for Image Processing and Computer Graphics at the Research Center Joanneum (1982-1985) in Graz, Austria.

One of her interests is to collect, develop and disseminate course information on computer graphics and visualization, so that educators in this field can evaluate and update their own courses according to these recommendations. Since 1992 she has been active in the ACM SIGGRAPH Education Committee to chair the subcommittee on "Education for Visualization". Currently (fall/winter 2007/2008) she is taking a sabbatical at the University of Colorado at Boulder at the Center for LifeLong Learning & Design (L3D).

#### Dieter W. Fellner

[www.igd.fraunhofer.de/igd-a0/staff/fellner/index.html.en](http://www.igd.fraunhofer.de/igd-a0/staff/fellner/index.html.en)

Dieter Fellner is director of the Fraunhofer Institute for Computer Graphics (IGD) in Darmstadt and professor of Computer Science at the Technical University at Darmstadt. He graduated from the Technical University of Graz, Austria. In Graz he established the new Institute of Computer Graphics and Knowledge Visualization in 2006. The research activities there covered algorithms and software architectures to integrate modeling and rendering, efficient rendering and visualization algorithms, generative and reconstructive modeling, virtual and augmented reality, graphical aspects of internet-based multimedia information systems and digital libraries. Dieter Fellner came to Graz from the Technical University of Braunschweig, Germany, where he had founded the Institute of Computer Graphics. Before that he had academic positions at the University of Bonn, Germany, the Memorial University of Newfoundland, Canada, the University of Denver, Colorado, and at the Graz University of Technology. After his studies of Technical Mathematics in Graz (Diploma 1981, Doktorate 1984, Habilitation 1988) his career started in the MUPID development team (1982), where he was responsible for the graphics components of the videotex decoder. Dieter Fellner's research projects comprise a broad spectrum of areas from formal languages, telematics services, and user interface design, to software engineering, computer graphics and digital libraries. In the latter field he has coordinated a strategic initiative funded by the German Research Foundation (Deutsche Forschungsgemeinschaft) from 1997 till 2005 which financed approx. 50 researchers per year in 21 research groups.

#### Holly Rushmeier

[www.cs.yale.edu/people/rushmeier.html](http://www.cs.yale.edu/people/rushmeier.html)

Holly Rushmeier is professor of Computer Science at Yale University. She received the BS, MS and PhD degrees in Mechanical Engineering from Cornell University in 1977, 1986 and 1988 respectively. Between receiving the BS and returning to graduate school in 1983 she worked as an engineer at the Boeing Commercial Airplane Company and at Washington Natural Gas Company (now a part of Puget Sound Energy). In 1988 she joined the Mechanical

Engineering faculty at Georgia Tech. While there she conducted sponsored research in the area of computer graphics image synthesis and taught classes heat transfer and numerical methods at both the undergraduate and graduate levels. At the end of 1991 Dr. Rushmeier joined the computing and mathematics staff of the National Institute of Standards and Technology, focusing on scientific data visualization.

From 1996 to early 2004 Dr. Rushmeier was a research staff member at the IBM T.J. Watson Research Center. At IBM she worked on a variety of data visualization problems in applications ranging from engineering to finance. She also worked in the area of acquisition of data required for generating realistic computer graphics models, including a project to create a digital model of Michelangelo's Florence Pieta, and the development of a scanning system to capture shape and appearance data for presenting Egyptian cultural artifacts on the World Wide Web.

Dr. Rushmeier has lectured at many meetings and academic institutions, including three invited keynote presentations at international meetings Eurographics Rendering Workshop 94 and Eurographics Conference 2001. She has spoken at and/or organized many tutorials and panels at the ACM SIGGRAPH and IEEE Visualization conferences.

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