

**SIGGRAPH 1990**

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On Computer Graphics and  
Interactive Techniques**

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## COURSE NOTES

# 8

**HUMAN FIGURE  
ANIMATION: APPROACHES  
AND APPLICATIONS**

***Chair***

**Tom Calvert**

**Simon Fraser University**

***Lecturers***

**Norman I. Badler**

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**David Zeltzer**

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# Human Figure Animation: Approaches and Applications

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## **Biographies**

**Dr. Norman I. Badler** is Professor of Computer and Information Science at the University of Pennsylvania and has been on that faculty since 1974. Active in computer graphics since 1968, his main areas of work include computer modeling, manipulation, and animation of human figures, interactive system design, and the application of artificial intelligence techniques to graphical problems.

Badler is a Senior Editor of *Computer Vision, Graphics, and Image Processing*, and is a Co-Editor of the new Journal *Graphical Models and Image Processing* when *CVGIP* splits in 1990. He is also the Associate Editor of *IEEE Computer Graphics and Applications*. He has served on the organizing and program committees of several major conferences, including the annual SIGGRAPH conference. He has also been a Vice-Chair of ACM SIGGRAPH. He currently directs a Computer Graphics Research Facility with two full time staff members and about 40 students. Badler received the BA degree in Creative Studies Mathematics from the University of California at Santa Barbara in 1970, the MSc in Mathematics in 1971, and the Ph.D. in Computer Science in 1975, both from the University of Toronto.

**Armin Bruderlin** is currently a PhD student in the School of Computing Science at Simon Fraser University in British Columbia, Canada. He is also a research assistant under Tom Calvert in the computer graphics lab at Simon Fraser University. His research interests include human animation, the use of dynamics for motion control in 3-D animation, general issues in Computer Graphics, Operating Systems as well as Artificial Intelligence. Armin received his B.Sc. in Computing Science from the Fachhochschule Furtwangen, Black Forest, (then or still) West Germany in 1984, and his M.Sc. in Computing Science from Simon Fraser University in 1988.

**Dr. Tom Calvert** is a Professor of Computing Science and Engineering Science at Simon Fraser University in British Columbia, Canada. He has degrees from University College London (BSc), Wayne State University (MSEE) and Carnegie-Mellon University (PhD). Following industrial appointments with ICI Ltd. and Canadair Ltd. he has held faculty appointments at Carnegie-Mellon University (1967-72) and Simon Fraser University (1972 - present). His research interests include human figure animation, intelligent CAD and computer vision.

**Thecla Schiphorst** is a choreographer, dancer, and animator, and holds a position as a senior faculty member in Computing at Douglas College in Vancouver, B.C. She also teaches contemporary dance composition and technique at the School for Contemporary Arts at Simon Fraser University. Thecla received her B.A. in dance from Simon Fraser University in 1984, and her diploma in Computer Programming and Systems Analysis from the British Columbia Institute of Technology in 1978. She is currently pursuing an interdisciplinary masters degree in the design of computer compositional systems for human movement.

**Dr. Jane Wilhelms** has been an assistant professor of Computer and Information Sciences at the University of California, Santa Cruz, since 1985. She received a M.A. in biology from Stanford University and an M.S. and Ph.D. in computer science from the University of California, Berkeley. She is a member of the editorial board of IEEE CG&A and is on the Siggraph technical committee for 1989, 1990, and 1991. Her main interests are computer animation, physical simulation, and scientific visualization.

**Dr. David Zeltzer** is Associate Professor of Computer Graphics in the Media Arts and Sciences Section at the Massachusetts Institute of Technology. He joined the faculty at MIT in 1984, after receiving his M.S. and Ph.D degrees in Computer and Information Science from Ohio State University in 1979 and 1984, respectively. He was awarded the B.S. in Mathematics, Magna cum Laude, from Southern Oregon State College in June 1978.

While at Ohio State, David was a research assistant at the Computer Graphics Research Group. His work there centered on modeling the kinematics of the human figure, and investigating goal directed animation of human movement, and he has produced animated sequences portraying a human skeleton walking over level and uneven terrain. Since September 1984, Dr. Zeltzer has been the director of the Computer Graphics and Animation Group at the MIT Media Laboratory. The efforts of this group are aimed at developing a graphical simulation environment which integrates robotics, artificial intelligence and computer graphics technologies to provide a visualization tool for learning, simulation and design. In addition to work in computer animation, David's research interests include biological and artificial motor control systems, and robotics.

## **Introduction**

Human figure animation provides a greater challenge than almost any other animation problem. Not only are human bodies more complex than any other object commonly animated, but as humans, we are uniquely sensitive to even the most subtle movement patterns of other humans. Thus we are very critical of both the patterns of movement and the way in which the body changes shape as it moves. By the same token, however, we are fascinated by the challenge of creating realistic human animation. We are lucky to have among the speakers of this course several researchers who have literally "written the book" on this topic.

The first half of this course sets out the basic approaches which are useful for human figure animation. Thecla Schiphorst will describe some classical kinematic approaches which include copying live action, key-framing and scripting languages. However, the classical approaches, although quite general, are also extremely tedious; this limits the quantity and quality of the resulting animation. One way to produce natural movement automatically is to simulate the biomechanics. Jane Wilhelms will describe how dynamic models of the body can be used to simulate natural movement and Armin Bruderlin will describe hybrid approaches which combine kinematics and dynamics. Another way to relieve the animator of detailed work is to develop techniques for high level specification of movement. David Zeltzer will describe high level approaches based on artificial intelligence.

The applications of human figure animation are only limited by our imagination and this course can only provide some pointers to what is possible. Norm Badler will describe the approaches he has developed for the ergonomic evaluation of environments. Thecla Schiphorst and Armin Bruderlin will give some examples of the use of realistic human figure animation for dramatic and artistic productions for film and video. David Zeltzer and Jane Wilhelms will describe the animation and simulation of microworlds. These animations allow a researcher to explore the nuances of interactions between simulated agents and the algorithms which characterize the behavioral characteristics of synthetic actors.

This course covers a lot of material - we hope that at the end of the day the participants will share the speakers enthusiasm for this field.

In April 1989, NSF and MIT sponsored a symposium which brought together researchers interested in different aspects of locomotion in articulated figures. The participants could be broadly classified as those interested in the biomechanics, physiology and psychology of human and animal locomotion, those interested in walking robots and those interested in human figure animation. The proceedings of this Symposium are now being published as a book with the title "Making Them Move: Mechanics, Control and Animation of Articulated Figures" edited by Norman Badler, Brian Barsky and David Zeltzer.

The speakers in the SIGGRAPH Course on Human Figure Animation had hoped to include this unique interdisciplinary book as part of the Course Notes but it could not be produced in time. However, the publishers, Morgan and Kaufmann have kindly agreed to give each Course Registrant a Coupon which will enable them to buy the book at a special discount (next page).

Tom Calvert