Modeling realistic human forms for animation has been one of the most difficult problems in computer graphics. This special issue presents a number of promising solutions.

Guest Editor’s Introduction

Human Body Models and Animation

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In the effort to create simulated worlds through computer graphics, modeling realistic human forms to populate these worlds has remained one of the most difficult and challenging problems. There are a number of reasons for this situation.

First, the human body is the antithesis of the shapes for which computer graphics modeling techniques are best suited—shapes such as flat facets, simple mathematical curves, or algebraic combinations of simple, primitive solids.

Second, the body is not rigid, but articulates in a number of ways, most of them nontrivial: the complex rotations of variously shaped joints, the effects of muscle actions, and the resultant changes in the surface of the skin.

Finally, the motions of a human body engaged in any typical activity are subtly complex, marked by an extraordinary degree of coordination, goal direction, and accommodation to internal and external forces and constraints. Thus, the effective animation of a realistic computer-synthesized figure requires the understanding, at one stage or another, of other disciplines that regularly study the human body and its motions: kinesiology, anthropometry, biomechanics, and biometrics. It is not surprising that most of the articles in this special issue describe work that has been performed in such an interdisciplinary, or at least cooperative, environment.

In spite of its complexities, the apparent universality of the human form—its joint and segment skeleton, its fixed topology, and even its relative uniformity of surface shape—has invited many attempts to model it graphically, and, in recent years, to model it by means of the computer. This issue starts with an article by William Fetter, who highlights the developmental history of a series of human figures, thus mirroring in miniature some concurrent developments in computer graphics modeling. A cross-sectional approach to human modeling systems is presented by Marianne Dooley, who surveys and compares a number of commercial and private systems aimed at evaluating human performance in designed environments. Kenneth Willmert describes and illustrates graphic analyses of a passive human figure responding to external forces in various situations.

When we want the movements of an animated figure to appear self-generated, we must consider many other issues besides physical reaction to external forces. The major problem is specifying the actions the figure is to perform so that the motions appear natural and coordinated—without imposing an excessive expressive burden on the system user, or the animator. Thomas Calvert,
John Chapman, and Aftab Patla describe a figure animation system based on motion specification through a movement notation or, alternatively, through the sensing of actual performed movement. David Zeltzer discusses a method based on finite-state machines and hierarchical control for simulating the coordinated gait (locomotion pattern) of a figure. In our article, my colleague, James Korein, and I survey a particular problem in motion control: the kinematic solution to goal achievement commands that might be given to a human or robot arm.

Two articles address separate, but important problems. Don Herbison-Evans considers the computational constraints in attempting the real-time, interactive animation of a human "puppet" built of ellipsoids. Frederic Parke describes the animation of a human face for expression, speech coordination, and growth studies, showing that the face presents very different motion modeling problems from those of a jointed skeleton.

I wish to thank all the authors and reviewers for their time, effort, and tremendous cooperation in bringing this special issue to fruition. I have certainly learned a great deal in assembling the issue, and I hope that it increases the accessibility of material in this area of computer graphics. I also expect it to benchmark the present state of human figure modeling and animation and to encourage exploration of the many questions and problems this research exposes.

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An associate editor of IEEE Computer Graphics and Applications, Badler is also a senior editor of Computer Graphics and Image Processing. He is a member of the Association for Computing Machinery, the IEEE Computer Society, the Cognitive Science Society, the American Association for Artificial Intelligence, Phi Beta Kappa, and the Dance Notation Bureau. In the past he has supervised the computer graphics tutorials at the ACM Siggraph national conference. In April 1979 he chaired the IEEE Computer Society Workshop on Computer Analysis of Time-Varying Imagery. He is a past vice-chairman of Siggraph.

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