

Digital Human Geometry Workshop - Medicine Meets Virtual Reality Meeting

1:15pm – 10pm, January 24, 2003; Newport Beach, CA

The objective of this workshop is to begin the development of a technical framework for modeling the geometry of biological objects, in the larger context of building interoperable simulations that constitute a Digital Human. The near-term goal is to examine approaches from computer graphics, gaming, diagnostic imaging and scientific visualization that can be used to fulfill the geometric and simulation needs of the project. This workshop represents one small step that can realize a clear deliverable to begin the larger development effort.

The discussion will involve both formal presentations and informal roundtable discussions. Topics include the creation of a generalized framework for building interoperable simulations for diverse applications such as surgical training and predictive experimentation, and the focused development of a technical benchmark for heart modeling.

The workshop is sponsored by The Learning Federation, National Science Foundation and Defense Advanced Research Projects Agency.

Speakers and discussants:

Gerry Higgins, Ph.D. (Federation of American Scientists)
Henry Kelly, Ph.D. (Federation of American Scientists)
Kay Howell (Federation of American Scientists)
Andries van Dam, Ph.D. (Brown University)
Scott Anderson (TAKSEA Productions)
Sascha Becker (Brown University)
Fred Bookstein, Ph.D. (University of Michigan)
M. Cenk Cavusoglu, Ph.D. (Case Western Reserve University)
Tony DeRose (Pixar Animation Studios)
Ron Fedkiw, Ph.D. (Stanford University)
Christopher Johnson, Ph.D. (University of Utah)
John Johnstone, Ph.D. (University of Alabama)
Manny Ko (3DO)
Andrew McCulloch, Ph.D. (University of California at San Diego)
Shankar Sastry, Ph.D. (University of California at Berkeley)
Richard Ward, Ph.D. (Oak Ridge National Laboratory)
Ned Way (SimQuest International LLC)

Items to be discussed:

(1) General approaches for a unified approach for modeling the geometry of a Digital Human

Questions include:

- ? Are there candidate approaches that have not yet been thoroughly considered? Is the proposed tube-based approach a reasonable first step? Or are the anatomical structures too complex for this?
- ? How do we query the model for information? How does the model specify connectivity?
- ? How do we separate the simulation from the view, so that simulations can be visualized in many different ways, on many platforms?

- ? Are there approaches for real-time graphics and computer architectures that may make this tractable in the near future for applications such as training and education?
- ? Have we defined the problem well enough to begin proposing and critiquing object models and APIs?

✍ **Specifications for a Heart Modeling “Bake-Off”**

- ? It has been proposed that we develop some basic geometry and an API consisting of a single-chambered heart with inflow and outflow, and that this be used as a benchmark for testing a variety of fluid/strain models.
- ? What do we need in terms of biological and clinical information about heart structure and function to develop the specification?
- ? Are there existing templates/benchmarks that can be used as a model for such a specification?
- ? Who will develop the geometry framework?

SESSION AGENDA

1:00pm	Henry Kelly, Ph.D.	President, Federation of American Scientists, Washington, D.C.	"Introduction to the Digital Human"
1:20pm	Gerry Higgins, Ph.D.	Federation of American Scientists; Co-Founder, SimQuest International LLC	"Building Geometry to Fit the Needs of the Simulation User"
1:40pm	Andries Van Dam, Ph.D.	Vice President for Research Thomas J. Watson, Jr., University Professor of Technology and Education and Brown University	"Families of Interoperable Clip Models"
2:00pm	Fred Bookstein, Ph.D.	Adjunct Professor, University of Michigan: Professor of Biometrics, Institute of Anthropology, University of Vienna	"Coordinate systems for Digital Humans"
2:20Pm	M. Cenk Cavusoglu, Ph.D.	Assistant Professor, Department of Electrical Engineering and Computer Sciences, Case Western Reserve University	"GiPSi: An Open Source/Open Architecture Software Development Framework for Surgical Simulation."
2:40 pm	BREAK		
3:00pm	Scott Anderson	SEA Image Productions	"Building the Hollow Man"
3:20pm	John Johnstone, Ph.D.	Associate Professor, Department of Computer and Information Sciences University of Alabama at Birmingham	"Various Options for Tubes"
3:40pm	Ron Fedkiw, Ph.D.	Assistant Professor, Computer Science Department Stanford University	"Simulation of Biological Tissue with Finite Volume Methods"
4:00pm	<p>Roundtable Discussion #1:</p> <ul style="list-style-type: none"> -Tony DeRose -Andy van Dam -Ron Fedkiw -Fred Bookstein -John Johnstone -Scott Anderson -Sascha Becker -Ned Way -Cenk Cavusoglu -Richard Ward -Henry Kelly -Gerry Higgins 	<p>(2) General approaches for a unified approach for modeling the geometry of a Digital Human.</p> <ul style="list-style-type: none"> ☞ Can any existing strategy for representing complex 3D structures be adapted for use in representing the full range of biological objects? What are the lessons learned from these approaches? Is a proposed tube-based approach a reasonable first step, or are anatomical structures too complex for this? ☞ Can a single approach support both the geometry needed to perform the physical simulation and the visualization? ☞ How can different levels of spatial resolution best be controlled? Can a single geometry be used to support physical modeling at many levels (e.g. models linking cell behavior to macroscopic organ behavior)? ☞ How can we best ensure that a system designed to work with currently available data can be upgraded to absorb increasingly sophisticated information in the next few years without abandoning the basic approach? ☞ Are there approaches for real-time graphics and computer architectures that may make this tractable in the near future for applications such as training and education? ☞ How can we best define a proposed approach and test it in an important practical setting? ☞ Have we defined the problem well enough to begin proposing and critiquing object models and APIs? 	
5:00pm	BREAK		
5:20pm	Christopher Johnson, Ph.D.	Director, Scientific Computing and Imaging Institute (SCI). Director, Center for Bioelectric Field Modeling, Simulation, and Visualization (NIH NCRR). Professor of Computer Science,	"Computational Heart Modeling"

		University of Utah Co-Founder, Visual Influence Inc.	
5:40pm	Andrew McCulloch, Ph.D.	Professor, Department of Bioengineering Whitaker Institute for Biomedical Engineering University of California, San Diego	“Structurally and Functionally Integrated Computational Models of the Heart”
5:40pm	Roundtable Discussion #2: -Chris Johnson -Andy McCulloch -Tony DeRose -Ron Fedkiw -Andy van Dam -Fred Bookstein -John Johnstone -Scott Anderson -Sascha Becker -Ned Way -Cenk Cavusoglu -Richard Ward -Henry Kelly -Gerry Higgins	(3) Specifications for a Heart Modeling “Bake-Off” <ul style="list-style-type: none"> ✍ It has been proposed that we develop some basic geometry and an API consisting of a single-chambered heart with inflow and outflow, and that this be used as a benchmark for testing a variety of fluid/strain models. ✍ How do we query the model for information? How does the model specify connectivity? ✍ What do we need in terms of biological and clinical information about heart structure and function to develop the specification? ✍ Are there existing templates/benchmarks that can be used as a template for such a specification? ✍ Who will develop the geometry framework? 	
7:00pm	Working DINNER		
8:30pm – 10:00pm	Roundtable Discussion #3:	(3) Next Steps	