Introduction to Data-Driven Animation:
Programming with Motion Capture

Jehee Lee

Seoul National University

(Organizer & Presenter)

Course Abstract

Data-driven animation using motion capture data has become a standard practice in character animation. A number of techniques have been developed to add flexibility on captured human motion data by editing joint trajectories, warping motion paths, blending a family of parameterized motions, splicing motion segments, and adapting motion to new characters and environments. Even with the abundance of motion capture data and the popularity of data-driven animation techniques, programming with motion capture data is still not easy. A single clip of motion data encompasses a lot of heterogeneous information including joint angles, the position and orientation of the skeletal root, their temporal trajectories, and a number of coordinate systems. Due to this complexity, even simple operations on motion data, such as linear interpolation, are rarely described as succinct mathematical equations in articles. This course provides not only a solid mathematical background but also a practical guide to programming with motion capture data. The course will begin with the brief review of affine geometry and coordinate-invariant (conventionally called coordinate-free) geometric programming, which will generalize incrementally to deal with three-dimensional rotations/orientations, the poses of an articulated figure, and full-body motion data. It will lead to identifying a collection of coordinate-invariant operations on full-body motion data and their object-oriented implementation. Finally, we will discuss the practical use of our programming framework in a variety of contexts ranging from data-driven manipulation/interpolation to state-of-the-art biped locomotion control.

About the Presenter

Jehee Lee
Associate Professor
School of Computer Science
Seoul National University
599 Gwanak-ro, Gwanak-gu
Seoul 151-742, Korea
(02) 880-1845
(02) 871-4912 Fax
jehee@cse.snu.ac.kr
http://mrl.snu.ac.kr/~jehee

Jehee Lee is an associate professor of Computer Science at Seoul National University. He received his B.S, M.S. and Ph.D. degrees in Computer Science from Korea Advanced Institute of Science and Technology in 1993, 1995, and 2000, respectively. He is leading the SNU Movement Research Laboratory. His research interests are in the areas of computer graphics and animation. More specifically, he is interested in developing new ways of understanding, representing, and animating human movements. This involves full-body motion analysis and synthesis, biped control and simulation, motion capture, motion planning, data-driven and physically based techniques, interactive avatar control, crowd simulation, and facial animation.

Course Schedule and Syllabus

Introduction and Overview (5 minutes)
1. Data-driven animation using motion capture data
2. Why is it difficult to do programming with motion capture data?
3. Course overview

Coordinate-Invariant Programming with Points and Vectors (20 minutes)
1. What is coordinate-invariant geometric programming?
2. Affine geometry
3. Coordinate-invariant operations between points and vectors

Programming with Orientations and Rotations (35 minutes)
1. Representing orientations and rotations
2. Analogy between points/vectors and orientations/rotations
3. Coordinate-invariant operations with orientations and rotations

Programming with Motion Capture Data (10 minutes)
1. Representing motion data and motion displacements
2. Coordinate-invariant operations for motion data

Practical examples (30 minutes)
1. Motion exaggeration and style transfer
2. Hierarchical displacement mapping
3. Interpolation and transitioning

References

Jehee Lee. 2008. Representing rotations and orientations in geometric computing. IEEE Computer Graphics and Applications 28, 2, 75–83.

Yoonsang Lee, Sungeun Kim, Jehee Lee, Data-Driven Biped Control, ACM Transactions on Graphics (SIGGRAPH 2010), Vol. 29, No. 4, Article 129, July 2010

Jehee Lee, Jinxiang Chai, Paul Reitsma, Jessica Hodgins and Nancy Pollard. 2002. Interactive Control of Avatars Animated with Human Motion Data, ACM Transactions on Graphics (SIGGRAPH 2002), volume 21, number 3, 491-500.

Hyun Joon Shin, Jehee Lee, Michael Gleicher, and Sung Yong Shin, Computer Puppetry: An Importance-based Approach, ACM Transactions on Graphics, volume 20, number 2, 67-94, April 2001.

Jehee Lee and Sung Yong Shin. 2002. General Construction of Time-Domain Filters for Orientation Data, IEEE Transactions on Visualization and Computer Graphics, volume 8, number 2, 119-128.

Jehee Lee and Sung Yong Shin. 2001. A Coordinate-Invariant Approach to Multiresolution Motion Analysis, Graphical Models, volume 63, number 2, 87-105.

Jehee Lee and Sung Yong Shin. 1999. A hierarchical approach to interactive motion editing for human-like figures. In Proceedings of SIGGRAPH 99, 39–48.