Full Body Motion

Presented by: Matt Boggus

The Task

- Animation of an entire body
  - Realism vs. Control
- Methods
  - Motion Capture
  - Physics Based
    - Dynamics
    - Kinematics
  - Animator Control

General Ideas

CONTROL FOR SIMULATED HUMAN AND ANIMAL MOTION, IFAC '98

- Open or Closed loop
- Sensory information
- Objectives for natural motion
- Characterize difficulty of motion
- Use of a priori data on motions
- Motion controllers
- Adjusting to the environment
- Interaction

Michiel van de Panne
University of Toronto

Dynamic Human Simulation: Towards Agile Animated Characters, ICRA '00

Comparing animation and robotics:

Hard vs. Soft physics

Observed vs. Synthetic motions

Degree of Autonomy

Visual quality vs. stability

Michiel van de Panne, Joe Laszlo, Pedro Huang, Petros Faloutsos

University of Toronto

Anatomy Inspired

Animating Human Athletics, SIGGRAPH '95

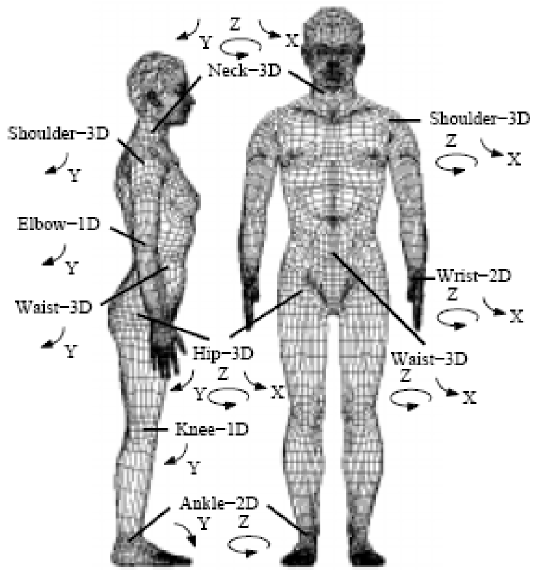
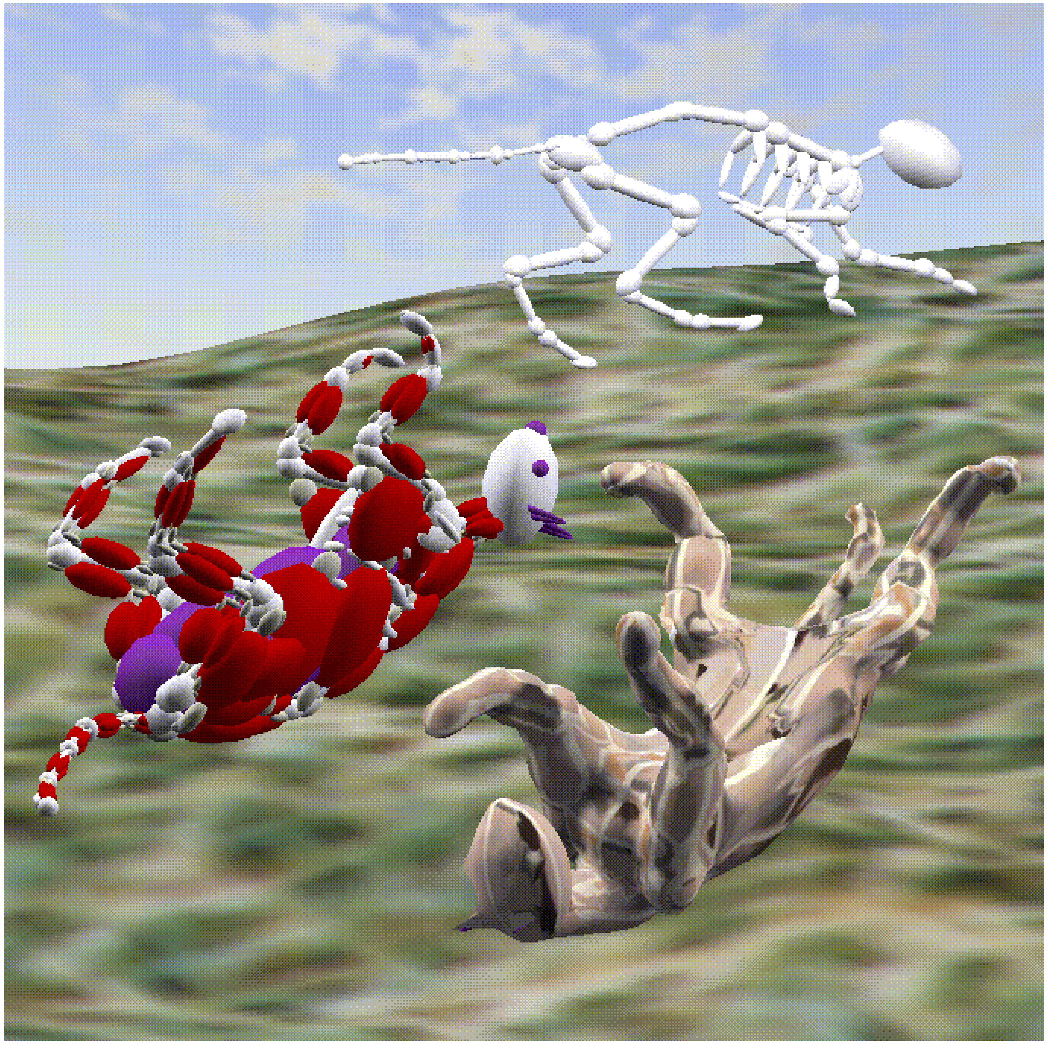


Figure 2: The controlled degrees of freedom of the human model. The gymnast represented in the figure has 15 body segments and a total of 30 controlled degrees of freedom. The runner has 17 body segments and 30 controlled degrees of freedom (two-part feet with a one degree of freedom joint at the ball of the foot and only one degree of freedom at the ankle), The bicyclist has 15 body segments and 22 controlled degrees of freedom (only one degree of freedom at the neck, hips, and ankles). The directions of the arrows indicates the positive direction of rotation for each degree of freedom. The polygonal models were purchased from Viewpoint Datalabs.

Jessica K. Hodgins,
Wayne L. Wooten,
David C. Brogan,
James F. O'Brien

Georgia Institute of Technology

Animals with Anatomy, CG&A '97

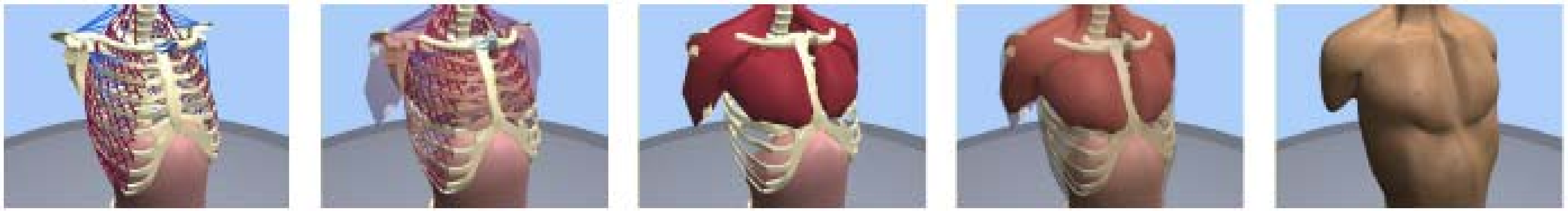


Jane Wilhelms

University of California, Santa Cruz

(Video)

Breathe Easy: Model and control of simulated respiration for animation, SCA '04



Victor B. Zordan, Bhrigu Celly, Bill Chiu, and Paul C. DiLorenzoy

University of California Riverside

(video)

Reflex Movements for a Virtual Human: a Biology Inspired Approach, Lecture notes in computer science ‘04

Mario Gutierrez,
Frederic Vexo, and
Daniel Thalmann

VRlab
EPFL Switzerland

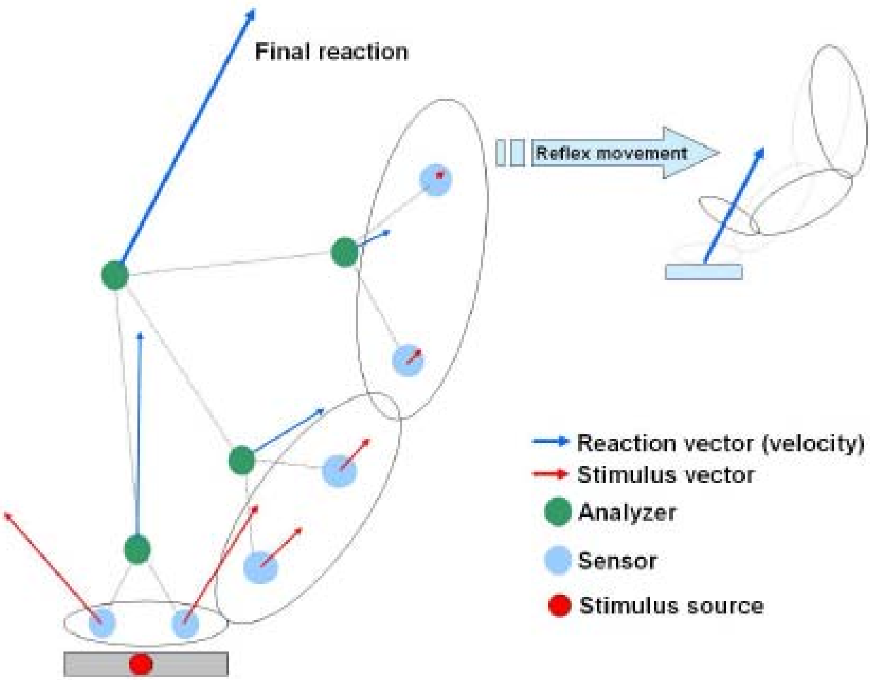


Fig. 2. The animation control for the arm.

Motion Editing and Physics

Motion Editing with Prioritized Constraints, I3D ‘97

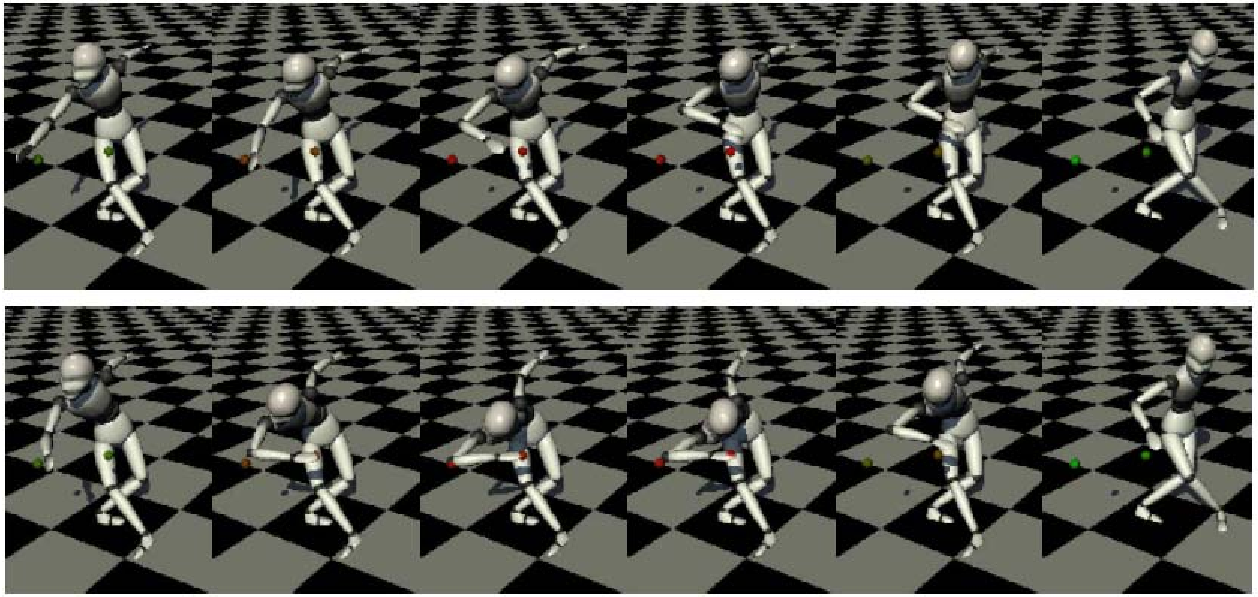


Figure 1: Example of motion editing with multiple prioritized constraints
(Top row: original motion, Bottom row: edited motion for arm and torso posture)

Ronan Boulic, Benoît le Callennec, Martin Herren, Herbert Bay

VRlab, EPFL Switzerland

Interactive Control For Physically-Based Animation, SIGGRAPH 2000

Joseph Laszlo,
Michiel van de Panne,
Eugene Fiume

University of Toronto

(videos)

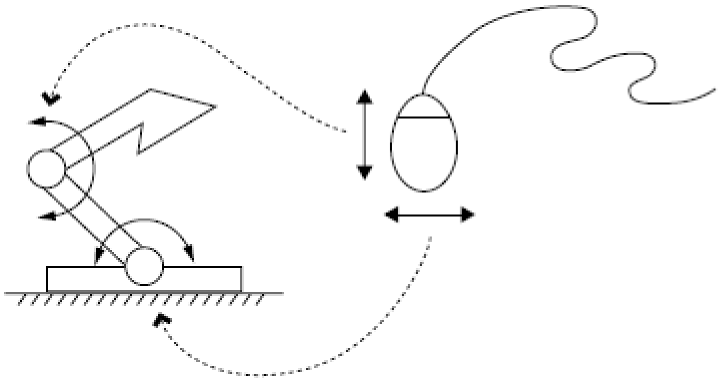
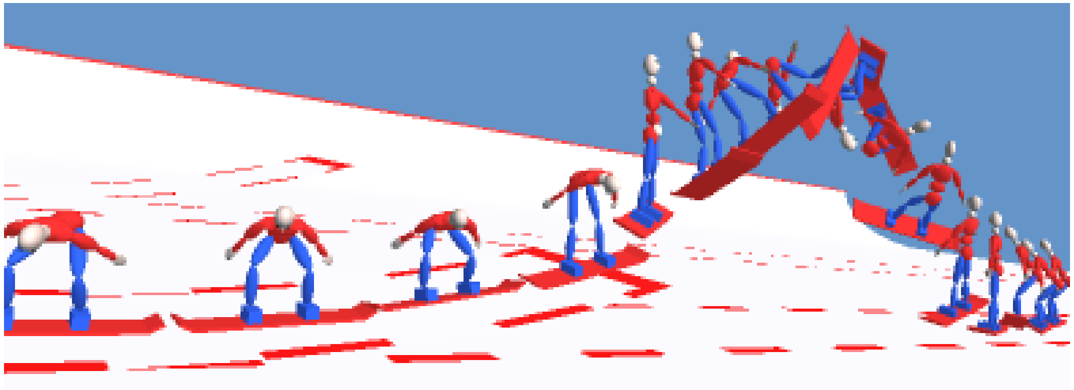


Figure 1: Interactive control for Luxo, the hopping lamp.

User Interfaces for Interactive Control of Physics-based 3D Characters, I3D ‘05

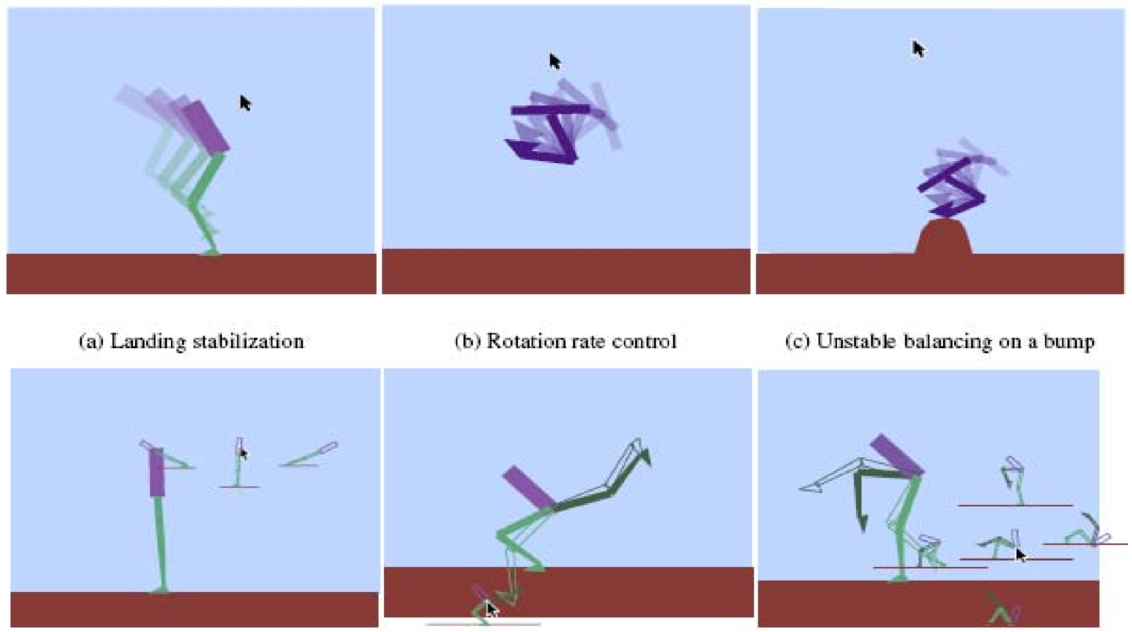


Peng Zhao Michiel van de Panne

University of British Columbia

(videos)

Predictive Feedback for Interactive Control of Physics-based Characters, Eurographics ‘05



(a) Landing stabilization (b) Rotation rate control (c) Unstable balancing on a bump

(d) Balancing - simple standing (e) An extreme arabesque (f) Dynamic posture variation

Figure 1: *Examples of interactively controlled actions that are difficult to perform without error due to unstable character state or poor indication of outcome for control input variations. Many interesting motions involve dynamic balance and fine timing.*

Joe Laszlo, Michael Neff, and Karan Singh
University of Toronto
(videos)

Dynamic Response for Motion Capture Animation, SIGGRAPH '05

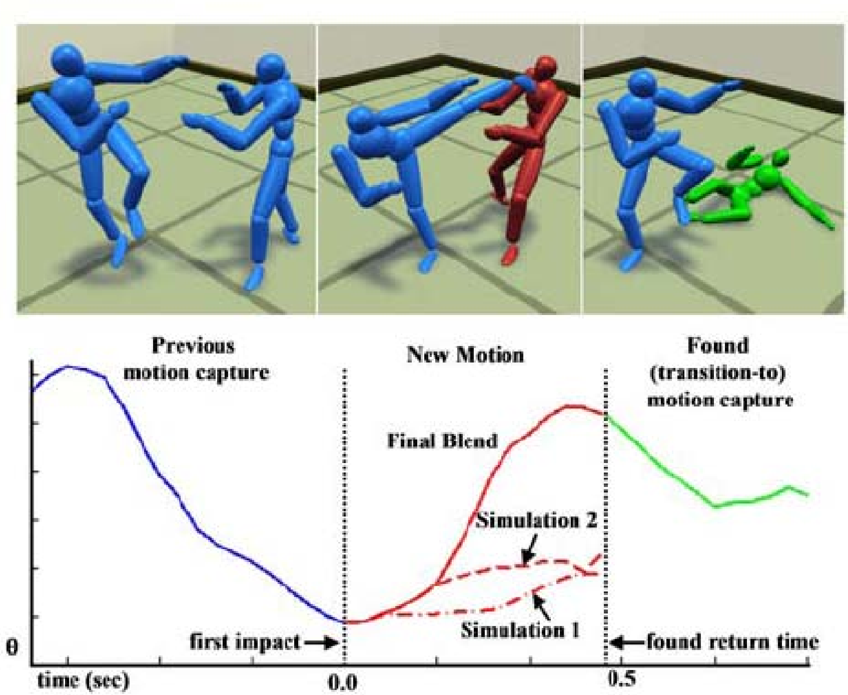


Figure 1: An example output from our system. The *red* synthesized (blend) motion fills in the gap between the *blue* and *green* motion capture segments played for the character being kicked. The synthesis and motion selection (of the *green* clip) are computed automatically by our system given the interaction which is about to take place in the left panel above. The plot shows the *Y*-value of the waist joint before, during, and after the interaction as well as two intermediate trajectories of simulated motion used by our system as described below.

Victor B. Zordan,
Anna Majkowska,
Bill Chiu,
Matthew Fast

University of California, Riverside

(videos)

Adaptation of Performed Ballistic Motion, SIGGRAPH ‘05

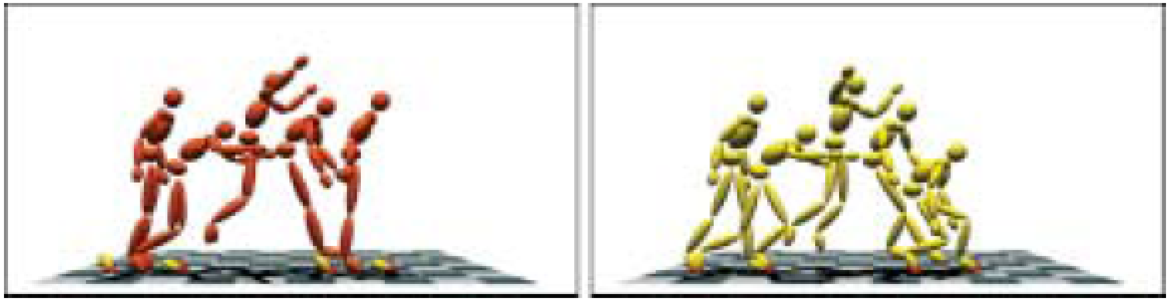


Fig. 1. The adaptation of a human broad jump (left figure) generates a new physically consistent jump (right figure) with a staggered takeoff and landing. An animator specifies only the new foot placement to evoke this change.

ADNAN SULEJMANPASIC
JOVAN POPOVIC

Massachusetts Institute of Technology

(videos)

Flipping with Physics: Motion Editing for Acrobatics, SCA '07

Anna Majkowska and Petros Faloutsos

University of California, Los Angeles

(video)

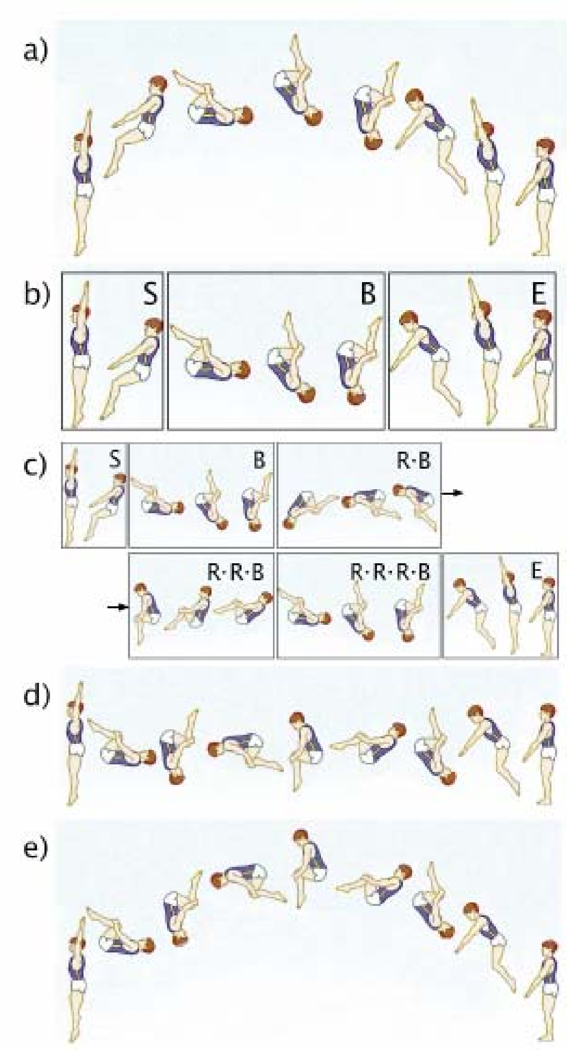


Figure 2: *Outline of the run-time jump generation stage of our algorithm. a) Input motion. b) First, the search algorithm finds a self-looping sequence B; root positions are ignored. c) Next, the sequence B is rotated around the angular momentum vector and repeated to obtain a double-flip. d) The resulting sequence is retimed to assure continuity of linear momentum during take-off and landing. e) In the final step, the character's COM is repositioned to follow correct trajectories under gravity.*

Others

Learning Physics-Based Motion Style with Nonlinear Inverse Optimization, SIGGRAPH '05

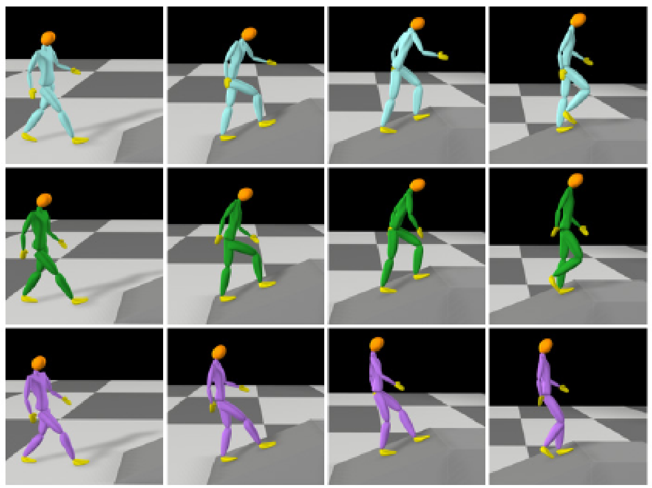


Figure 7: Comparison to motion warping and ground truth. *Top:* Motion capture of a person walking up a ramp. *Middle:* Motion predicted by our method, using a style learned from walking on a level surface. Although the prediction is not identical to the motion capture sequence, our method has accurately predicted the overall dynamic nature of the motion, such as leaning into the slope, and exerting more force at each step. *Bottom:* Motion predicted by warping the level motion and smoothing the motion while satisfying foot constraints. Many dynamic features of the ground truth are absent from the warped motion.

C. Karen Liu, Zoran Popovic

University of Washington

Aaron Hertzmann

University of Toronto

(videos)

Geostatistical Motion Interpolation, SIGGRAPH '05

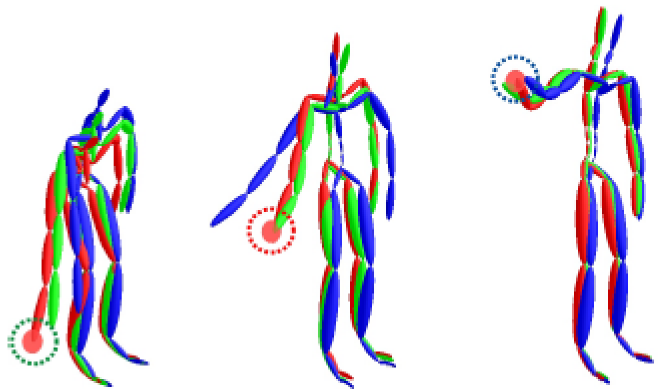


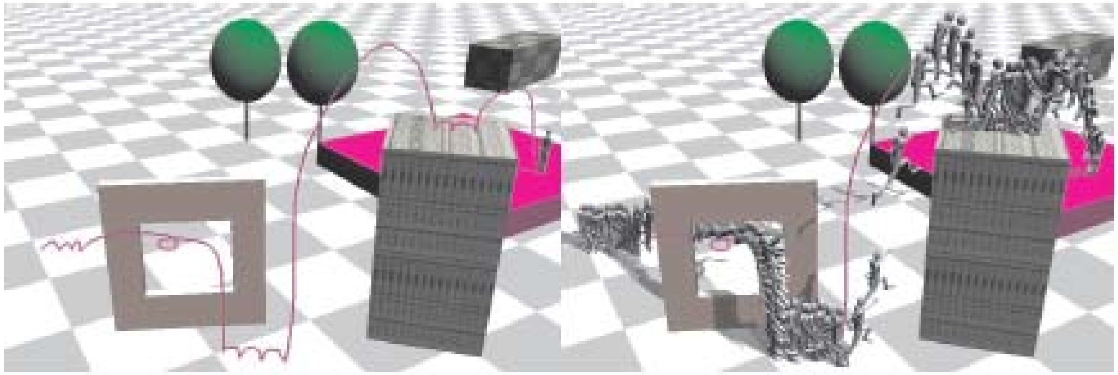
Figure 7: Comparison of sampled and synthesized motions via cross validation. Skeletal figures colored red show motion samples, while blue and green figures represent the synthesized motions with RBF and per-pose interpolations, respectively.

Tomohiko Mukai, Shigeru Kuriyama

Toyohashi University of Technology

(video)

Motion Doodles: An Interface for Sketching Character Motion, SIGGRAPH ‘04



Matthew Thorne, David Burke, Michiel van de Panne

University of British Columbia

(video)

Style Translation for Human Motion, SIGGRAPH '05

Eugene Hsu, Kari Pulli — MIT

Jovan Popovic — Nokia Research Center

(video)

Figure 1: Our style translation system transforms a normal walk (TOP) into a sneaky crouch (MIDDLE) and a sideways shuffle (BOTTOM).

The Future

- Optimization (Real-time methods)
- Motion in dynamic environments, A.I.
- User Interfaces
- Blend mocap, physics, behavior, and control