Dr. Yili Zhao

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Research Interests

Physically-based simulation, numerical simulation, real-time physics, applied mathematics, computer graphics, computer animation

Education

University of Southern California, Los Angeles, CA
Ph.D. in Computer Science, August 2009 - June 2014 (defended in April 2014).
Improving my botanical simulator at USC during Summer 2014, funded by my advisor Prof. Barbič until August 15, 2014.
Ideal job start: September 15, 2014.
Dissertation Title: *Plant Substructuring and Real-time Simulation Using Model Reduction*
Committee: Jernej Barbič (advisor), Gaurav S. Sukhatme, Ulrich Neumann, Igor Kukavica, Stefan Schaal

Peking University, Beijing, China
M.S. in Computer Science, September 2006 - July 2009
Thesis Title: *Acceleration Techniques in Rendering Large-scale and Complex Scenes*
Advisor: Guoping Wang

Nanjing University of Aeronautics and Astronautics, Nanjing, Jiangsu, China
B.S. in Computer Science, September 2002 - June 2006 (Ranked **2^{nd} out of 268**)
Thesis Title: *Research on Segmentation of three-dimensional Meshes with Color and Texture*
Advisor: Songcan Chen, Liyan Zhang

Visa Status

F-1 OPT: the initial 1-year OPT begins on September 15, 2014; all forms have been filed with USCIS.

Research Experience

University of Southern California, Los Angeles, CA
Graduate Research Assistant, advisor: Jernej Barbič, August 2010 - August 2014

- **Developed a real-time system for simulation of anatomically realistic plants (trees, flowers, bushes, forests, etc.).** See Figure 1. Published at ACM SIGGRAPH 2011. It can simulate complex plants at interactive rates, subject to user forces, gravity or randomized wind. It can procedurally and automatically set the material properties, timesteps, and damping. It provides plant fracture, and inverse kinematics to easily pose plants.
  Video 1: Oregon White Oak, realistic anatomy, adult tree, 120,000 leaves
  Video 2: Real-time physically-based simulation of plants

- **Developed a robust system to convert plant "polygon soup" triangle meshes into non-linear FEM mechanical models suitable for physically based simulation.** Published at ACM SIGGRAPH 2013. I delivered the 20-minute SIGGRAPH presentation. It can process anatomically realistic geometry of an adult plant in a manner of minutes and handle complex plants in the presence of imperfections in input geometry.

- **Developed an algorithm to simulate time-varying, geometrically complex, penalty-based distributed contact between many rigid objects and articulated objects.** Published at *IEEE Transactions on Visualization and Computer Graphics*. It improves simulation stability regardless of the number of contacts and the sizes and orientations of contact areas. It can simulate very challenging contact scenarios such as screwing a hexbolt into a hole, and bowls stacked in perfectly conforming configurations.
  Video: Implicit Multibody Penalty-based Distributed Contact

- **Code contributor to Vega FEM library**, a computationally efficient and stable C/C++ physics library for three-dimensional deformable object simulation. It models large deformations, including geometric and material nonlinearities, and can also efficiently simulate linear systems.

Figure 1: Simulating forest in randomized wind: 13 firs, **1,055,964** triangles, **118,001** domains, **63,154** reduced DOFs, simulation fps: **4** Hz. This result is an improved version of the demos from our SIGGRAPH 2013 paper.

University of Southern California, Los Angeles, CA
Graduate Research Assistant, advisor: Suya You, August 2009 - May 2010

- Developed an augmented reality system that allows user to virtually walk in a large-scale and complex scene with many textured three-dimensional building models.

Peking University, Beijing, China
Graduate Research Assistant, advisor: Guoping Wang, September 2006 - July 2009

- Developed algorithms to accelerate rendering of a large-scale, complex scene with many three-dimensional massive models (funded by China National High-tech Research and Development Program).
- Developed algorithms to detect and repair the irregularities on three-dimensional triangle meshes (funded by National Grand Fundamental Research Program of China).

Nanjing University of Aeronautics and Astronautics, Nanjing, Jiangsu, China
Undergraduate Research Assistant, advisor: Songcan Chen, Liyan Zhang, September 2005 - June 2006

- Developed an algorithm based on quadric error metrics to segment three-dimensional triangle meshes with color and texture properties.

Publications

Hongyi Xu*, **Yili Zhao***, Jernej Barbič: "**Implicit Multibody Penalty-based Distributed Contact.**" IEEE Transactions on Visualization and Computer Graphics, Volume 20, 2014 (** joint first authors*)

Yili Zhao and Jernej Barbič. "**Interactive authoring of simulation-ready plants.**" *ACM Transactions on Graphics*, Vol. 32, No. 4, (SIGGRAPH 2013) (July 2013)

Jernej Barbič and **Yili Zhao**. "**Real-time large-deformation substructuring.**" *ACM Transactions on Graphics*, Vol. 30, No. 4, (SIGGRAPH 2011) (July 2011)

Honors and Awards

Best Poster for Visual Presentation, Department of Computer Science, USC, 2012, 2013

Chiang Chen Scholarship, Peking University, 2006 (**1 of 20** winners, university-wide)

Excellent Graduate 2006, NUAA, June 2006 (**top 1%**)

Bronze medal, the 29^{th} ACM International Collegiate Programming Contest (Hangzhou site, 2005)

Member of Outstanding Student Program, NUAA, An elite subset of University Undergraduate Program, 2003 - 2004 (Ranked $\mathbf{2^{nd}}$ **out of 32**)

Excellent Student Scholarship, $\mathbf{1^{st}}$ **Prize** , NUAA, 2003 - 2006 (Consecutive **4** years, **top 2%**)

Skills

Technologies learned (not limited to): classical mechanics (forward/inverse kinematics/dynamics, etc.), Finite Element Method simulation, robotics (PD, PID controller, etc.), advanced linear algebra (polar decomposition, singular value decomposition, eigenvalue problem, high-dimensional space, etc.), numerical methods (optimization, Lagrange multiplier method, implicit numerical integration, etc.), model reduction, domain decomposition and substructuring, shape matching, collision detection, contact handling, sound simulation, mass-spring systems, skinning, cloth simulation, motion capture, quaternions, C/C++ advanced concepts (polymorphism, virtual inheritance, etc.), design patterns, parallel programming.

Languages: C/C++ (since 2002), LaTeX, HTML; I am learning Python.

Tools: gcc, Makefiles (Linux), MS Visual Studio, OpenMP, OpenGL, GLUT, Intel MKL library, yafaray (raytracing engine), GLUI, Fast Light Toolkit (FLTK), gnuplot, Subversion code version control system.

Software: vi, MATLAB, Autodesk Maya, Adobe Photoshop, Adobe Illustrator, Adobe After Effects.

Platforms: Mac OS X, Linux, Windows. All three used on a regular basis.

Teaching Experience

Teaching Assistant

- CS 520: Computer Animation and Simulation, USC, Spring 2012, 2013, 2014
- CS 599: Physically Based Modeling for Interactive Simulation and Games, USC, Spring 2011
- 04830060: Computer Programming, Peking University, Spring 2008
- 04830530: Introduction to Computing, Peking University, Fall 2007
- 04830495: Practice of Interesting Algorithms, Peking University, Spring 2007

Guest Lecture

- "Inverse Kinematics", CS 520: Computer Animation and Simulation, USC, Spring 2014
- "Rigid Body Dynamics", CS 520: Computer Animation and Simulation, USC, Spring 2013
- "Fluid Simulation", CS 520: Computer Animation and Simulation, USC, Spring 2012

Interview (of me, as a Teaching Assistant, at USC)

- A Perspective of a Teaching Assistant at USC

Paper Reviews

- Computers & Graphics 2013

Related Coursework

USC PhD:
CSCI 599 Physically Based Modeling for Interactive Simulation and Games
CSCI 670 Advanced Analysis of Algorithms
CSCI 545 Robotics
CSCI 574 Computer Vision
CSCI 580 3D Graphics and Rendering
CSCI 571 Web Technologies

Peking Univ. MS:
Advanced Computer Graphics
Advanced Computer Architecture
Advanced Software Engineering

References

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MIT TR35 Winner, Sloan Fellow
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Dr. Gaurav S. Sukhatme, Professor,
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