Nobuyuki Umetani

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Associate Professor
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PERSONAL SUMMARY

Currently, I am an associate professor in the University of Tokyo. Before joining the position, I was a project lecturer in the same university and I also worked at Autodesk Research in Toronto as a research scientist leading the Design and Fabrication group. Before that, I worked for Disney Research Zürich (with Bernd Bickel) and Autodesk Research (with Ryan Schmidt) as a postdoctoral researcher for one year each. I am interested in computer graphics, physics-based simulation, interactive design interface and mechanical engineering, especially:

- Integrated Design, Simulation and Interaction
- Interactive Simulation
- Computational Fabrication
- Finite Element Methods
- Data-driven Aerodynamics Modeling
- Biomechanical Simulation
- Geometry Processing for Machine Learning

I finished my Ph.D. in September 2012 under the supervision of Prof. Takeo Igarashi. When I was a master's student, I visited the applied mathematics department in TU Delft (the Netherlands) and worked with Prof. Scott MacLachlan and Prof. Kees Oosterlee. After I started my Ph.D, I visited Columbia University in New York and work with Danny Kaufman and Prof. Eitan Grinspun. In another research visit for my Ph.D., I collaborated with Prof. Niloy Mitra at the University College London. In addition, I won an internship at Microsoft Research Asia (working with Weiwei Xu and Xin Tong) in February 2012.

WORK EXPERIENCE

Associate Professor (April 2020 – present)
The University of Tokyo, Tokyo, Japan

Project Lecturer (July 2018-March 2020)
The University of Tokyo, Tokyo, Japan

Research Scientist (March 2015-June 2018)
Autodesk Research, Toronto, Canada

Postdoctoral Researcher (March 2014-February 2015)
Disney Research Zürich, Switzerland

Project Researcher (December 2013-Februrary 2014)
The University of Tokyo/JST ERATO, Japan

Fix-term Research Scientist (November 2012-November 2013)
Autodesk Research, Toronto, Canada

Internship Researcher (February 2012-May 2012)
Microsoft Research Asia, Beijing, China
Supervisor: Dr. Weiwei Xu

Research Fellow (April 2010-October 2012)

Japan Society for the Promotion of Science

Research Assistant (2008 - 2010)
JST ERATO Igarashi Design Interface Project, Japan
Supervisor: Dr. Takeo Igarashi

Chief Developer (2008)
Information – technology Promotion Agency (IPA) Exploratory Software Project, Japan
Supervisor: Dr. Ikuo Takeuchi

EDUCATION

Ph.D., Computer Science (October 2009 – September 2012)
The University of Tokyo, Japan
Thesis: Interactive Design Exploration of Physically Valid Shapes
Adviser: Takeo Igarashi

M.S., Frontier Science (April 2006 – September 2009)
The University of Tokyo, Japan
Thesis: Coupling analysis of skeletal muscles and skeletal system using Lagrange multiplier
Adviser: Toshiaki Hisada

B.S., Mechanical Engineering (April 2002 – March 2006)
The University of Tokyo, Japan
Thesis: Analysis of open and close phase of heart valve by changing connectivity in time step
Adviser: Toshiaki Hisada

PUBLICATION (JOURNAL)

[1] Nobuyuki Umetani, Bernd Bickel, Learning three-dimensional flow for interactive aerodynamic design, ACM Transaction on Graphics (SIGGRAPH 2018)

[2] Nobuyuki Umetani, Athina Panotopoulou, Ryan Schmidt, Emily Whiting , "Printone: Interactive Resonance Simulation for Free-form Print-wind Instrument Design", ACM Transaction on Graphics (SIGGARPH Asia 2016)

[3] Nobuyuki Umetani, Ryan Schmidt , "SurfCuit: Surface Mounted Circuits on 3D Prints", IEEE Computer Graphics and Applications

[4] Tobias Martin*,Nobuyuki Umetani*,Bernd Bickel (*=joint 1st authors), "OmniAD: Data-driven Omni-directional Aerodynamics", ACM Transaction on Graphics (SIGGRAPH 2015), 34(4), July, 2014

[5] Nobuyuki Umetani, Takeo Igarashi, Niloy J. Mitra, "Guided Exploration of Physically Valid Shapes for Furniture Design", CACM Research Highlights, Communications of the ACM

[6] Nobuyuki Umetani, Yuki Koyama, Ryan Schmidt, Takeo Igarashi, "Pteromys: Interactive Design and Optimization of Free-formed Free-flight Model Airplanes" ACM Transaction on Graphics (SIGGRAPH 2014), 33(4), July, 2014

[7] Weiwei Xu*, Nobuyuki Umetani*, Qianwen Chao, Jie Mao, Xiaogang Jin, Xin Tong (*=joint 1st authors), "Sensitivity-optimized Rigging for Example-based Real-time Clothing Synthesis", ACM Transaction on Graphics (SIGGRAPH 2014), 33(4), July, 2014

[8] Shunsuke Saito, Nobuyuki Umetani, Shigeo Morishima, "Macroscopic and Microscopic Deformation Coupling in Up-sampled Cloth Simulation", Computer Animation and Virtual Worlds Journal, CASA 2014 Special Issue, 25(3-4), May-August, 2014

[9] Susumu Katayama, Nobuyuki Umetani, Toshiaki Hisada, Seiryo Sugiura, "Bicuspid aortic valves undergo excessive strain during opening: A simulation study", The Journal of Thoracic and Cardiovascular Surgery, 2013

[10] Nobuyuki Umetani, Takeo Igarashi, Niloy J. Mitra, "Guided Exploration of Physically Valid Shapes for Furniture Design", ACM Transaction on Graphics (SIGGRAPH 2012), 31(4), August, 2012.

[11] Takashi Ijiri, Takashi Ashihara, Nobuyuki Umetani, Takeo Igarashi, Ryo Haraguchi, Hideo Yokota, and Kazuo Nakazawa, “A Kinematic Approach for Efficient and Robust Simulation of the Cardiac Beating Motion”, PLos One.

[12] Bo Zhu, Michiaki Iwata, Ryo Haraguchi, Takashi Ashihara, Nobuyuki Umetani, Takeo Igarashi, Kazuo Nakazawa. Sketch-based Dynamic Illustration of Fluid Systems. SIGGRAPH ASIA 2011

[13] Nobuyuki Umetani, Danny Kaufman, Takeo Igarashi, Eitan Grinspun, "Sensitive Couture for Interactive Garment Editing and Modeling", ACM Transaction on Graphics (SIGGRAPH 2011), 30(4), August, 2011

[14] Nobuyuki Umetani, Kenshi Takayama, Jun Mitani, Takeo Igarashi, "Responsive FEM for Aiding Interactive Geometric Modeling", Computer Graphics & Applications

[15] Nobuyuki Umetani, Scott Maclachlan, Kees Oosterlee, "A Multigrid-Based Shifted-Laplacian Preconditioner for a Fourth-Order Helmholtz Discretization”, Numerical Linear Algebra with Applications, Volume 16, Issue 8, pp603-626,(2008)

[16] Susumu Katayama, Nobuyuki Umetani, Seiryo Sugiura, and Toshiaki Hisada, "The sinus of Valsalva relieves abnormal stress on aortic valve leaflets by facilitating smooth closure", The Journal of Thoracic and Cardiovascular Surgery, vol.136, no.6, pp.1528-1535,(2008)

PUBLICATION (CONFRENCE)

[17] Nobuyuki Umetani, “Exploring Generative 3D Shapes Using Autoencoder Networks”, Siggraph Asia 2017 Technical Brief

[18] Rubaiat Habib, Tovi Grossman, Nobuyuki Umetani, George Fitzmaurice, “Motion Amplifiers: Sketching Dynamic Illustrations Using the Principles of 2D Animation”, CHI 2016 Conference proceedings

[19] Andrew O. Sageman-Furnas, Nobuyuki Umetani, Ryan Schmidt, “Meltables: Fabrication of Complex 3D Curves by Melting”, SIGGRAPH Asia 2015 Technical Brief

[20] James McCrae, Nobuyuki Umetani, Karan Singh, “FlatFitFab: Interactive Modeling with Planar Sections”, In Proceedings of the ACM User Interface Software and Technology (UIST ‘14).

[21] Nobuyuki Umetani, Ryan Schmidt, Jos Stam, “Position-based Elastic Rod”, In Proceedings of the 21014 ACM SIGGRAPH/Eurographics Symposium on Computer Animation (SCA ‘14)

[22] Nobuyuki Umetani, Ryan Schmidt, “Cross-sectional Structural Analysis for 3D Printing Optimization”, SIGGRAPH Asia 2013 Technical Brief

[23] Yupeng Zhang, Teng Han, Zhimin Ren, Nobuyuki Umetani, Xin Tong, Yang Liu, Takaaki Shiratori, Xiang Cao, “BodyAvatar: Creating freeform 3D avatars using first-person body gestures”, In Proceedings of the ACM Symposium on User Interface Software and Technology (UIST ‘12).

[24] Yuki Koyama, Kenshi Takayama, Nobuyuki Umetani, and Takeo Igarashi, “Real-time example-based elastic deformation”, In Proceedings of the 2012 ACM SIGGRAPH/Eurographics Symposium on Computer Animation (SCA '12)

[25] Nobuyuki Umetani, Kenshi Takayama, Jun Mitani, Takeo Igarashi, "Designing Custom-made Metallophone with Concurrent Eigenanalysis", In Proceedings of the 2010 New Interfaces for Musical Expression (NIME++2010)

[26] Yohsuke Furuta, Nobuyuki Umetani, Jun Mitani, Takeo Igarashi and Yukio Fukui, "A Film Balloon Design System Integrated with Shell Element Simulation" (short paper), Eurographics 2010

PUBLICATION (BOOK)

"Introduction of Finite Element Methods in Computer Graphics", CG Gems JP 2013, chapter 11 (in Japanese).

"Clothing Simulation and Self-collision Handling using Finite Element Method", CG Gems JP 2012, chapter 9 (in Japanese).

PATENT

Nobuyuki Umetani, Machine learning three-dimensional fluid flows for interactive aerodynamic design, US Patent App. 15676941, 2019/2/14

Rubiait Habib, Tovi Grossman, Nobuyuki Umetani, George Fitzmaurice, Techniques for generating dynamic illustrations using principles of animation, US Patent App. 15133103, 2017/10/19

Nobuyuki Umetani, Ryan Michael Schmidt, Andrew O'Shea SAGEMAN-FURNAS. Techniques for approximating three-dimensional curves using foldable beams, US Patent App. 14935156, 2017/3/9

Nobuyuki Umetani, Ryan Michael Schmidt. Techniques for performing cross-sectional stress analysis for three-dimensional objects, US Patent App. 14544156, 2015/6/4

Ryan Michael Schmidt, Nobuyuki Umetani, Jos Stam, Techniques for modeling elastic rods in position-based dynamics frameworks, US Patent App. 20160154906, 2019/5/23

Ryan Schmidt, Nobuyuki Umetani, Techniques for optimizing orientation of models for three-dimensional printing, US 14544158, 2015/6/4

Xiang Cao, Yang Liu, Teng Han, Takaaki Shiratori, Nobuyuki Umetani, Yupeng Zhang, Xin Tong, Zhimin Ren, Object creation using body gestures, US Patent App. 15888572, 2018/6/7

Eitan Grinspun, Daniel M Kaufman, Nobuyuki Umetani, Takeo Igarashi, Methods, systems, and media for interactive garment modeling and editing, US Patent App. 13883563, 2014/4/24

AWARDS

Young Researcher Award, Asia Graphics (2018)

Microsoft Research Asia Fellowship (2011)

Best Paper Award (2010)
WISS 2010(Japanese UIST), 18th Workshop on Interactive Systems and Software

Yamanouchi Award (2009)
IPSJ(Japanese ACM), Japanese Symposium on Programming

SUPER CREATER (2008)
Information-technology Promotion Agency (IPA) Exploratory Software

TEACHING

Nihon University, Multimedia Expression (part-time lecturer), Winter 2019

University of Toronto, Geometry Processing (guest lecture on 3D Printing), Winter 2017

University of Toronto, Computer Graphics (guest lecture), Fall 2017

SIGGRAPH 2015 Course, "Computational Tool for 3D printing" together with Bernd Bickel and Wojciech Matusik

RESEARCH VISITS

Computer Science Department, University College London, UK (August2011-November-2011)
Mentor: Niloy J. Mitra

Columbia Computer Graphics Group, Computer Science Department, Columbia University, USA (April 2010-March 2011)
Mentor: Eitan Grinspun

Numerical Analysis Group, Delft Institute of Applied Mathematics, Delft University of Technology, The Netherlands (April 2007-March 2008)
Mentor: Kees Oosterlee

PROFESSIONAL SERVICE

Program Committee

Euro Graphics short paper: 2017-2019
CASA: 2017, 2018
Pacific Graphics: 2015,2016,2019
Symposium on Computer Animation: 2016-2018
CAD/Graphics: 2017,2019
WSCG: 2017
ACM SIGGRAPH Technical Paper: 2015
SCM CHI Papers: 2019
ACM SIGGRAPH ASIA Brief and Poster: 2015

Associate Editor

The Visual Computer: 2016-2017

Reviewer

SIGGRAPH: 2012 - 2012
SIGGRAPH Asia: 2011 - 2019
TOG: 2015, 2016, 2019
Eurographics: 2012 - 2019
CGF: 2015 – 2019
CHI: 2017,2018
UIST: 2016 - 2019
GrapdiFab: 2016, 2017
3DUI: 2014
IEICE: 2014
Pacific Graphics: 2014-2019
TVCG: 2014 - 2019
WSCG: 2017
CAD: 2016

INVITED TALK

"Machine Learning CFD for Interactive Aerodynamic Design", University of Toronto, Computational Science and Engineering Symposium 2019, May 2019

Interactive Design Optimization in Computational Fabrication, CAD/Graphics 2019, Keynote talk, May 2019

"Making 3D Prints more Functional using Electronics and Machine Learning", Host: Dagstuhl Seminar "Computational Aspects of Fabrication", September 2018

"Robust Shape Parameterization for Machine Learning, Host", Workshop on Robust Geometric Algorithms for Computational Fabrication, May 2018

Interactive design optimization for computational fluid dynamics, Host Bellairs Workshop on on Computer Animation: Inverse modeling problems for physics-based animation, February 2017

"Simulation-guided Interactive Exploration of Functional Design", September 2016, Host: Stelian Coros: VASC Seminar at Carngie Mellon University

"Simulation-guided Interactive Exploration of Functional Design", McGill university, Host: Paul Kry, May 2016,

"Simulation-guided Interactive Exploration of Functional Design", Host: Kun Xu, Pacific Graphics 2015 Invited Talk, October 2015

"Simulation-Guided Creation: Interactive Simulation to Animate and Fabricate your Own Idea", Host: Marie-Paule Cani:"Expressive modeling : New advances towards the seamless creation of 3D content", June 2015

"Interactive Design of Functional Shapes", Schloss Dagstuhl, Germany, September 2014,
Host: Dagstuhl Seminar: "Computational Aspects of Fabrication"

"Interactive Authoring for Designing Physically Valid Shapes", University of Manitoba, May 2013,
Host: Jim Young

"Interactive Exploration of Physically Valid Shapes", Disney Research Zurich, February 2013,
Host: Bernd Bickel

"Integration of Design, Simulation and Interaction", Max Planck Institute Infomatik, October 2011,
Host: Michael Wand

"Interactive integration of design and real-time simulation", New York University, September 2010
Host: Kenshi Takayama

SOFTWARE

DelFEM2: https://github.com/nobuyuki83/delfem2
This is a C++/Python toolkit for solving various partial differential equations (PDE) using finite element method (FEM). The user can run FEM simulation on a shape with just ~20 lines of Python code. The library provides end-to-end solution and equips with all the component requires for digital engineering such as CAD system, mesh generator, FEM solver, linear solver, and their visualizer all implemented by the author. DelFEM2 is aiming for interactive digital engineering and authoring tool.

Structural weakness detection for Autodesk MeshMixer®: http://www.meshmixer.com/
During my post-doc in Autodesk, I developed weak structure detection function for Autodesk MeshMixer. This function detects breakable location in a complicated 3D structure in a fraction of a second. This function is used for computational vilification of design for 3D printing. This technology was newly developed and described in a paper "Cross-sectional Structural Analysis for 3D printing".

Hair simulation for Autodesk Maya, Nucleus®: http://www.autodeskresearch.com/projects/nucleus
During my post-doc in Autodesk, I developed new version of hair simulation component for Nucleus. Nucleus is a simulation library for Maya, which is visual computing widely used design software in the computer animation industry.

Technical Skills

- C++ Coding
  - Expert level. More than 10 years of experience. I can develop and maintain large scale (over 100 thousands lines) cross-platform software. I am familiar with modern style C++11 coding.
  - I can write a C++ python binding with PyBind11
  - I have in depth knowledge of OpenGL and familiar with modern version of OpenGL. I can write shaders with GLSL.
  - I have few years experience of CUDA-based GPGPU programming.
- Python Coding
  - Expert level. Three years of experience. I am familiar with many packages (numpy,scipy,pytorch,tensorflow,PyQt)
- Other program languages
  - Though not as good as C++ and Python, I can code JavaScript, C#, Fortran, Java well.
- I have experience with collaborative development using git. I'm familiar with continuous integration tools like travis.ci and wercker.
- Software: MAYA, Blender, Houdini, Paraview, Fusion 360

Language Proficiency

- Japanese: Native
- English: Fluent
- Chinese: Intermediate
- French: Elementary