Zachary Ferguson

CONTACT	Computer Science and Artificial Intelligence Laboratory	Algorithmic Design Group

CONTACT

Computer Science and Artificial Intelligence Laboratory   Algorithmic Design Group
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RESEARCH INTERESTS

Computer graphics, simulation, physically-based animation, collision detection and response, digital fabrication, geometric modeling, geometry processing

EDUCATION

New York University, New York, NY   Fall 2017–Spring 2023
Doctor of Philosophy in Computer Science   Advisor: Daniele Panozzo
Thesis: *Provably Robust and Accurate Methods for Rigid and Deformable Simulation with Contact*

George Mason University, Fairfax, VA   Fall 2013–Spring 2017
Bachelor of Science in Computer Science; minor in Mathematics
Honors: *summa cum laude* (GPA: 3.96/4.00)

EMPLOYMENT

Massachusetts Institute of Technology, Postdoctoral Associate   Fall 2023–Present
Supervisor: Mina Konaković Luković, Algorithmic Design Group (ADG)

- Research in differentiable simulation and metamaterial design.

New York University
Assistant Research Scientist   Summer 2023
Graduate Research Assistant   Fall 2017–Spring 2023
Advisor: Daniele Panozzo, Geometric Computing Lab (GCL)

- Researched algorithms for computer graphics, physically-based animation, simulation, geometry processing, and collision detection.
- Led the development of several open-source including the IPC Toolkit and PolyFEM.
- Collaborated with several team members and across universities to conduct cutting-edge research.
- Supervised masters and undergraduate students on research projects related to computer graphics and physical simulation.

Adobe Research, Research Scientist Intern   Summer 2018/2022
Mentors: Danny Kaufman and Qingnan Zhou

- Implemented adaptive meshing algorithms for improved physical simulation results and performance.
- Research published as "In-Timestep Remeshing for Contacting Elastodynamics" in *ACM Transactions on Graphics*.

Carbon, Computational Geometry Intern   Summer 2021–Spring 2022
Supervisors: Weixiong Zheng and Hardik Kabaria

- Researched and implemented simulation systems for physically validating lattice structures with contact.

George Mason University, Undergraduate Research Assistant   Fall 2015–Summer 2017
Advisor: Yotam Gingold, Creativity and Graphics Lab (CraGL)

- Research published as "Seamless: Seam erasure and seam-aware decoupling of shape from mesh resolution" in *ACM Transactions on Graphics*.

PUBLICATIONS

1 Differentiable solver for time-dependent deformation problems with contact. Zizhou Huang*, Davi Colli Tozoni*, Arvi Gjoka, **Zachary Ferguson**, Teseo Schneider, Daniele Panozzo, and Denis Zorin. *ACM Transactions on Graphics*, 2024. To be presented at *SIGGRAPH 2024*
(paper, video)

2 A systematic comparison between FEBio and PolyFEM for biomechanical systems. Liam Martin, Pranav Jain, **Zachary Ferguson**, Torkan Gholamalizadeh, Faezeh Moshfeghifar, Kenny Erleben, Daniele Panozzo, Steven Abramowitch, and Teseo Schneider. *Computer Methods and Programs in Biomedicine*, 244:107938, 2024
(paper)

3 In-Timestep Remeshing for Contacting Elastodynamics. **Zachary Ferguson**, Teseo Schneider, Danny M. Kaufman[†], and Daniele Panozzo[†]. *ACM Transactions on Graphics (Proceedings of SIGGRAPH)*, 42(4), 2023
(project page, paper, video, code, data)

4 High-Order Incremental Potential Contact for Elastodynamic Simulation on Curved Meshes. **Zachary Ferguson**, Pranav Jain, Denis Zorin, Teseo Schneider, and Daniele Panozzo. In *ACM SIGGRAPH 2023 Conference Proceedings*, 2023
(project page, paper, video, code, data)

5 LibHip: An open-access hip joint model repository suitable for finite element method simulation. Faezeh Moshfeghifar, Torkan Gholamalizadeh, **Zachary Ferguson**, Teseo Schneider, Michael Bachmann Nielsen, Daniele Panozzo, Sune Darkner, and Kenny Erleben. *Computer Methods and Programs in Biomedicine*, 226:107140, 2022
(paper, data)

6 Open-Full-Jaw: An open-access dataset and pipeline for finite element models of human jaw. Torkan Gholamalizadeh, Faezeh Moshfeghifar, **Zachary Ferguson**, Teseo Schneider, Daniele Panozzo, Sune Darkner, Masrour Makaremi, François Chan, Peter Lampel Søndergaard, and Kenny Erleben. *Computer Methods and Programs in Biomedicine*, 224:107009, 2022
(paper, data)

7 A Cross-Platform Benchmark for Interval Computation Libraries. Xuan Tang, **Zachary Ferguson**, Teseo Schneider, Denis Zorin, Shoaib Kamil, and Daniele Panozzo. In *Proceedings of the 14th International Conference on Parallel Processing and Applied Mathematics*, 2022
(project page, paper)

8 Fast and Exact Root Parity for Continuous Collision Detection. Bolun Wang, **Zachary Ferguson**, Xin Jiang, Marco Attene, Daniele Panozzo, and Teseo Schneider. *Computer Graphics Forum (Proceedings of Eurographics)*, 41(2), 2022
(project page, paper, code)

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*Joint first authors
[†]Joint last authors

9   A Large Scale Benchmark and an Inclusion-Based Algorithm for Continuous Collision Detection. Bolun Wang*, **Zachary Ferguson***, Teseo Schneider, Xin Jiang, Marco Attene, and Daniele Panozzo. *ACM Transactions on Graphics*, 40(5), 2021. Presented at *SIGGRAPH 2022*
(project page, paper, code, data)

10 Intersection-free Rigid Body Dynamics. **Zachary Ferguson**, Minchen Li, Teseo Schneider, Francisca Gil-Ureta, Timothy Langlois, Chenfanfu Jiang, Denis Zorin, Danny M. Kaufman, and Daniele Panozzo. *ACM Transactions on Graphics (Proceedings of SIGGRAPH)*, 40(4), 2021
(project page, paper, video, code)

11 DHFSlicer: Double Height-Field Slicing for Milling Fixed-Height Materials. Jinfan Yang, Chrystiano Araújo, Nicholas Vining, **Zachary Ferguson**, Enrique Rosales, Daniele Panozzo, Sylvain Lefevbre, Paolo Cignoni, and Alla Sheffer. *ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia)*, 39(6), 2020
(project page, paper)

12 Incremental Potential Contact: Intersection- and Inversion-free Large Deformation Dynamics. Minchen Li, **Zachary Ferguson**, Teseo Schneider, Timothy Langlois, Denis Zorin, Daniele Panozzo, Chenfanfu Jiang, and Danny M. Kaufman. *ACM Transactions on Graphics (Proceedings of SIGGRAPH)*, 39(4), 2020
(project page, paper, video, code)

13 Stitch Meshing. Kui Wu, Xifeng Gao, **Zachary Ferguson**, Daniele Panozzo, and Cem Yuksel. *ACM Transactions on Graphics (Proceedings of SIGGRAPH)*, 37(4), 2018
(project page, paper, video)

14 Seamless: Seam erasure and seam-aware decoupling of shape from mesh resolution. Songrun Liu*, **Zachary Ferguson***, Alec Jacobson, and Yotam Gingold. *ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia)*, 36(6), 2017
(project page, paper, video, code)

Awards

Adobe Research Fellowship 2022
Adobe Inc.

Dean's Dissertation Fellowship 2022
Graduate School of Arts and Science, New York University

Jacob T. Schwartz Ph.D. Fellowship 2021
Courant Institute of Mathematical Science, New York University

Henry M. MacCracken Fellowship 2017
Graduate School of Arts and Science, New York University

Distinguished Academic Achievement Award 2017
Computer Science Department, George Mason University

PEC Solutions Endowed Scholarship 2016
Volgenau School of Engineering, George Mason University

Dean's Scholarship 2015
Volgenau School of Engineering, George Mason University

Selected Talks

Towards Robust and Accurate Simulation of Contacts August 2022
International Conference on Multibody Systems, Nonlinear Dynamics, and Control (MSNDC)

March 29, 2024

COURSES	Contact and Friction Simulation for Computer Graphics. Sheldon Andrews, Kenny Erleben, and **Zachary Ferguson**. In *ACM SIGGRAPH 2022 Courses*, 2022. (course content)

TEACHING

Summer Geometry Initiative, Teaching Assistant
Project: Intrinsic Mollification   Summer 2023

New York University, Teaching Assistant
Special Topics: Computer Graphics (CSCI-UA.0480)   Fall 2019

iD Tech, Instructor
Game Programming for Apple iOS and Android with Unity   Summer 2015

PROFESSIONAL ACTIVITIES

ACM SIGGRAPH, Reviewer	2020, 2022–2024
ACM SIGGRAPH Asia, Reviewer	2022, 2023
Eurographics, Reviewer	2024
Computer-Aided Design, Reviewer	2021, 2023
Computers & Graphics, Reviewer	2018, 2021
Computer Aided Geometric Design, Reviewer	2020

OPEN-SOURCE PROJECTS

I have created, developed, and maintained several open-source projects for physical simulation. Through this work, I seek to democratize physical simulation tools and enable others to leverage the power of our algorithms.

- IPC Toolkit (C++ and Python): ipctk.xyz
- PolyFEM (C++): polyfem.github.io
- IPC (C++): github.com/ipc-sim/ipc
- Tight-Inclusion CCD (C++): github.com/continuous-collision-detection/tight-inclusion
- Rigid IPC (C++): github.com/ipc-sim/rigid-ipc

TECHNICAL SKILLS

Programming Languages: C/C++, Python, CUDA, JavaScript
Technologies: CMake, Git, Eigen, Catch2, PyTorch, OpenGL (GLSL)
  – **Physics Engines**: NVIDIA PhysX, Bullet Physics, Box2D, Project Chrono
  – **Game Development:** Unity (C#), Phaser (JavaScript)
  – **Web Development:** HTML, CSS, JavaScript
Tools: Blender, ParaView, Fusion 360
Math and Physics: linear algebra, numerical optimization, finite element method, physics-based animation, cloth/elastodynamics simulation