

Eitan Grinspun

CONTACT

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BIRTH DATE

1975 August 15

EDUCATION

Ph.D. Cand. in Computer Science (degree expected June 2003).

Caltech, Pasadena, CA.

Dissertation: *The Basis Refinement Method*.

Adviser: Peter Schröder (Multi-Res Modeling Group).

Committee: Alan Barr, Mathieu Desbrun, Jerrold E. Marsden, Petr Krysl.

M.S. in Computer Science (June 2000).

Caltech, Pasadena, CA.

Thesis: *Automated Layout for VLSI*.

Adviser: Alain Martin (Asynchronous VLSI Group).

B.A.Sc. in Engineering Science (June 1997).

University of Toronto, Toronto, Ontario, Canada.

Ranked 1st in Computer Science option.

Thesis: *Ray Tracing on Field-Programmable Gate Arrays*.

Adviser: James Stewart (Dynamic Graphics Project).

DOCTORAL THESIS

The Basis Refinement Method

CHARMS (Conforming Hierarchical Adaptive Refinement Methods) is an adaptive simulation technology that spans the spectrum from real-time animation for games, realistic animation for film, to predictive power for engineers and scientists.

RESEARCH INTERESTS

Computer graphics: animation, geometry, modeling, simulation

Cross-disciplinary research: applied mathematics, biology, compilers, mechanics, visual art.

- PUBLICATIONS Eitan Grinspun, Anil Hirani, Mathieu Desbrun & Peter Schröder. **Discrete shells**. Submitted for publication, 2003.
- Jeff Bolz, Ian Farmer, Eitan Grinspun & Peter Schröder. **The GPU as numerical simulation engine**. Submitted for publication, 2003.
- Petr Krysl, Eitan Grinspun & Peter Schröder. **Natural hierarchical refinement for finite element methods**. *Int. J. Numer. Meth. Engng.*, 56(8):1109 – 1124, 2003.
- Eitan Grinspun, Petr Krysl & Peter Schröder. **CHARMS: a simple framework for adaptive simulation**. *ACM Transactions on Graphics (TOG)*, 21(3):281 – 290, 2002. Also in *Proceedings of ACM Siggraph 2002*.
- Eitan Grinspun & Peter Schröder. **Normal bounds for subdivision-surface interference detection**. In *Proceedings of the conference on Visualization 2001*, pages 333 – 340. IEEE Press, 2001.
- Eitan Grinspun, Fehmi Cirak, Peter Schröder & Michael Ortiz. **Non-linear mechanics and collisions for subdivision surfaces**. Technical report, Caltech, 1999.
- Eitan Grinspun. **Gretel: An interactive layout router for magic**. Master's thesis, Caltech, 1999.

GRANTS &
HONORS

- Everhart Lecturer** Caltech (forthcoming 2003)
Caltech Distinguished Graduate Lecture Series
Three annual institute-wide talks awarded to students with “(1) a clear understanding of the current state of the research field and its broader implications, and incorporation of the students research contributions and (2) dynamic speaking skills that will both capture the audiences attention and convey the research topic in a clear and concise manner, understandable to a widely varying technical audience.” (<http://www.its.caltech.edu/~els>)
- NVIDIA Fellow** Caltech (2002 – 2003)
Merit-based fellowship.
- Caltech Special Institute Fellow** Caltech (1997 – 1999)
Merit-based fellowship.
- NSERC Grant** for graduate studies (declined) Toronto (1995)
National Science and Engineering Research Council of Canada Grant.
- NSERC Grant** for summer research U. of Toronto (1995)
Topic: *Parallelizing Compilers*.
Adviser: Tarek S. Abdelrahman.
- Garnet W. McKee-Lachlan Gilchrist Scholar** U. of Toronto (1995)
Merit-based scholarship.
- Dean's candidate** U. of Toronto (1994)
National Canadian C.D. Howe Memorial Foundation Award.
One candidate per university.
- Hewlett Packard Award** U. of Toronto (1994)
Awarded to top student in computer science class.
- Paulin Memorial Scholarship** U. of Toronto (1994)
Merit-based entrance scholarship.
- Toronto Scholar** U. of Toronto (1994)
Merit-based entrance scholarship.
- Gold Medal** U. of Guelph (1993)
University of Guelph Annual Software Development Contest.
University of Guelph, Guelph, Ontario, Canada.

- PRESENTATIONS: **Everhart Lecture**, Awarded presentation Caltech (forthcoming 2003)
 INVITED & TENTATIVE title: *Multi-Resolution in Graphics and Simulation, or Why is inflating valentines day balloons important for brain surgery?*
 REFEREED AWARDED a campus-wide presentation, honorarium & recognition at Caltech's commencement ceremony.
- Alumni Weekend**, Invited presentation Caltech (2003)
Multi-Resolution in Graphics and Simulation, or Why is inflating valentines day balloons important for brain surgery?
 The Caltech Alumni Weekend includes a Seminar Day in which selected professors and students are invited to give a one hour presentation to Caltech alumni.
- CIMMS Seminar**, Invited presentation Caltech (2002)
The Method of Basis Refinement
 The Center for Integrative Multiscale Modeling and Simulation (CIMMS) is a multi-disciplinary center for the modeling and analysis of complex phenomena across multiple time and length scales.
- ACM Siggraph 2002**, Refereed paper presentation San Antonio, TX (2002)
CHARMS: A Simple Framework for Adaptive Simulation
 ACM Siggraph is the premiere venue for research on computer graphics.
- CACR Seminar**, Invited presentation Caltech (2001)
Conforming Hierarchical Adaptive Refinement Methods
 The Center for Advanced Computing Research (CACR) is a multi-disciplinary center focused on high-performance computer-based modeling for the study of scientific phenomena and engineering designs.
- IEEE Scientific Visualization 2001**, Refereed paper San Diego, CA (2001)
Normal bounds for subdivision-surface interference detection
 This conference, sponsored by IEEE and ACM, is the premiere venue for research on scientific visualization.
- Schloss Dagstuhl, Workshop on Subdivision in Geometric Modeling and Computer Graphics**, Invited presentation Wadern, Germany (2000)
Non-Linear Mechanics and Collisions for Subdivision Surfaces
 Schloss Dagstuhl, Octaviallee, D-66687 Wadern, Germany.
- PRESENTATIONS: **Dynamic Graphics Project**, Seminar lecture U. of Toronto (2002)
 POSTERS & *CHARMS: A Simple Framework for Adaptive Simulation*
 SEMINARS
- Caltech Computer Science Department**, Seminar lecture Caltech (2002)
CHARMS: A Simple Framework for Adaptive Simulation
- Dynamic Graphics Project**, Seminar lecture U. of Toronto (2002)
Multi-Resolution Physical Simulation
- Joint IDR-IMA Workshop on Ideal Data Representation**, Poster presentation Minneapolis, MN (2001)
Adaptive Finite Element Computations for Subdivision Surfaces
 Inst. for Mathematics and its Applications (IMA), Univ. of Minnesota, Minneapolis, MN.
- Workshop on the Convergence of Graphics, Vision, and Video**, Poster presentation Berkeley, CA (2000)
Self-Collision Detection of Subdivision-Surfaces
 University of California, Berkeley, CA.
- OPAAL Site Reviews**, Poster presentations (2000-2002)
 Site reviews for OPAAL (Optimized Portable Algorithms and Application Libraries) initiative for complex physical simulation.

RESEARCH
EXPERIENCE**Multi-Resolution Simulation of Protein Folding** Caltech (2003)

Collaborator: Julia Shifman. Purpose: to explore novel multi-resolution simulation algorithms for the multi-scale protein folding problem. Personal contributions: computer science, simulation, and numerical solvers expertise; preliminary discussions.

Spatially- and Temporally-Adaptive Parallel Solvers for Nonlinear Elasticity Caltech (2003)

Collaborators: Adrian Lew, Michael Ortiz, Matias Zielonka. Purpose: to incorporate both basis-refinement (CHARMS), for spatial adaptivity, and asynchronous variational integrators, for temporal adaptivity, into a parallel finite-element solver and to demonstrate applications in nonlinear elasticity. Personal contributions: consultation on specializing and incorporating CHARMS into Michael Ortiz's code base; work in progress.

Discrete Mechanics of Thin Shells Caltech (2002 – 2003)

Collaborators: Mathieu Desbrun, Tom Duchamp, Anil Hirani, Jerrold E. Marsden & Peter Schröder. Purpose: to develop a discrete-geometrical description of the laws governing thin shells. Personal contributions: study of continuous shell theory, development of axiomatic discrete energies, implementation of discrete shell simulation testbed and incorporation of postulated energies; publication submitted, work in progress.

Adaptive Fluid Solver Caltech (2002 – 2003)

Collaborators: Mathieu Desbrun, Mark Meyer, Jos Stam & Peter Schröder. Purpose: to create an adaptive solver for the Navier-Stokes equation of fluid flow. Personal contributions: expertise in adaptive computation, collaboration in converting existing finite-difference approach to a finite-element approach, implementation of OpenCHARMS adaptivity infrastructure, and discussions to develop refinement metrics and test scenarios; publication in development; work in progress.

CHARMS: Conforming Hierarchical Adaptive Refinement Methods Caltech (2000 – 2002)

Collaborators: Petr Krysl & Peter Schröder. Purpose: to develop a simple and universal approach to adaptive solvers for partial differential equations. Personal contributions: creation of original concept and its application to the Subdivision Element Method (SEM), collaboration with Petr Krysl to specialize and apply to the Finite Element Method; published results in two journals and several workshops/conferences, including *ACM Transactions on Graphics*, *Proceedings of Siggraph 2002*; Ph.D. dissertation in progress.

Self-collision Detection for Subdivision Surfaces Caltech (2000 – 2001)

Collaborators: Adi Levin & Peter Schröder. Purpose: to develop bounds on the Gauss map of a subdivision surface and use those bounds in an efficient self-interference detection algorithm. Personal contributions: derivation of bounds using eigenanalysis; design and implementation of collision detection algorithm; experimental measurement of results; refereed paper in *Proceedings of IEEE Scientific Visualization 2001*.

Implementation of Subdivision Element Method Caltech (1999 – 2000)

Collaborators: Fehmi Cirak & Peter Schröder. Purpose: to implement the thin shells Subdivision Element Method (SEM) research infrastructure including Loop-Biermann subdivision rules, object-oriented design, and interface for adaptive solvers. Personal contributions: architect and implement the SEM infrastructure; published as technical report, work in progress.

Automated Layout for VLSI Caltech (1998 – 1999)

Collaborators: Alain Martin & Robert Southworth. Purpose: to develop a fast, flexible, interactive router with automated path planning. Personal contributions: flexible/generalized technique for representing and propagating solution-fitness-values in a tile-based router; implementation as an extension to the *Magic* layout package; published as Master's thesis.

CAST: Caltech Asynchronous Synthesis Tools Caltech (1998 – 1999)

Collaborators: Matthew Hanna, Rajit Manohar & Robert Southworth.

Purpose: CAST is a specification language for VLSI designs, with associated compilers & design tools. Personal contributions: together with Matthew Hanna, the development and formal specification of the CAST 2.0 language; published as technical report.

CSIM: Simulator for Asynchronous Systems Caltech (1997 – 1998)

Collaborator: Matthew Hanna.

Purpose: to design and implement a high-performance simulation of *production-rule specifications*. Personal contributions: design and C++ implementation of micro-kernel for the production-rule simulator; improved both the performance and memory footprint of the simulator by a factor of three compared with similar simulators; published as technical report; design served as a basis for an industrial simulator (at *Fulcrum Microsystems*) and for a research simulator (by Dr. Paul Penzes).

Ray Tracing on FPGAs U. of Toronto (1997)

Collaborators: James Stewart & Jonathan Rose.

Purpose: to implement a ray-tracer on Field-Programmable Gate Array (FPGA) hardware. Personal contributions: independent study under guidance of advisers; design and implementation of adder, multiplier, divider, and ray/triangle intersection-detection units; published as Bachelor's thesis in Engineering Science Division.

Parallelizing Optimizing Compilers U. of Toronto (1996)

Collaborator: Tarek S. Abdelrahman.

Purpose: to extend the *Polaris* compiler with parallelizing optimizations targeted for (non-uniform memory access) shared-memory architectures. Personal contribution: summer research project under guidance of adviser; implementation of unimodular transformations for nested loops; implementation of flow-graph generation.

TEACHING
EXPERIENCE

Hacking the GPU Caltech course CS101.3 Caltech (2002)

Teaching Assistant for Peter Schröder.

Personal Contributions: collaborative curriculum development of novel class; preparation and delivery of selected lectures (e.g., mesh smoothing, class project overviews); hosting visiting lecturers. Topics: streaming architectures, NV30 hardware, NVIDIA's Cg language, Conjugate Gradient solvers and their application to mesh smoothing, Multigrid solvers, Navier-Stokes.

Topics in Geometric Modeling Caltech course CS175 Caltech (2000 – 2001)

Teaching Assistant for Igor Guskov (2001) and Peter Schröder (2000).

Personal Contributions: Preparation and delivery of selected lectures (e.g., blossoms and splines, subdivision theory); grading of assignments, office hours.

Topics: mesh simplification, theory and practice of splines, subdivision surfaces.

Algorithms and Computational Geometry Caltech course CS138 Caltech (2000)

Teaching Assistant for Mani Chandy and Peter Schröder.

Personal Contributions: Grading and private tutoring during office hours. Topics quarter 1: proving algorithms, reducing problems to prove hardness, the formal language UNITY, the dining philosophers problem, etc.; Topics quarter 2: convex hulls, Voronoi regions, Delauney triangulations, kd-trees, etc.

Concurrency in Computation Caltech course CS139 Caltech (1998 – 1999)

Teaching Assistant for Alain Martin.

Personal Contributions: design and grading of selected assignments, delivery of two lectures (on slack elasticity and implementation of an $O(\log \log n)$ adder), assistance in organizing class project (on CSP Specification of a Stack Processor). Topics: Communicating Sequential Processes (CSP), mutual exclusion and synchronization, simulation and trace of CSP, class project.

OTHER
PROFESSIONAL
EXPERIENCE**Referee**

ACM Transactions on Graphics, ACM SIGGRAPH, Graphics Interface, ACM Symposium on Computer Animation, Eurographics.

Judge, SURF Speaking Awards Caltech (2000 – 2001)
Summer Undergraduate Research Fellowship (SURF) Speaking Awards.

Technical Consultant, Shamrock Holdings, Inc. (2000 – 2001)
Technical evaluations for investment decisions.

Systems Consultant, Registered Nurses' Association of Ontario Toronto (1995 – 2001)
Consultation on networking, Internet & systems administration.

Graphic-Arts and Software Consultant, Dynamic Visions Ltd. Toronto (1995)
Toronto, Ontario, Canada.
Graphics modeling, lighting and rendering using *3D Studio*; game programming; software design for a virtual reality platform; collaboration with game company *Apogee*.

Software Developer, Marshall McLuhan Centre Toronto (1993)
C++/Toolbook development of interactive visual database system.

Independent Contractor, Mount Sinai Hospital Toronto (1992 – 1993)
Complete private development under contract of the product *Power*Survey*; design, development, documentation and deployment of networked survey-distribution, collection, & analysis software.

LANGUAGES

English, Spanish & Hebrew: Fluent.

French: Working knowledge.

OTHER
INTERESTS

Sports: swimming, racquet sports, weight training. **Outdoors:** hiking, climbing, gardening.

Cultural: playing piano & African drums, jazz, classical music, cooking/dining.

REFERENCES

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