

# Josef B. Spjut

Harvey Mudd College 301 Platt Blvd. Claremont, CA 91711

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Academic research in the areas of Computer Graphics and Computer Architecture and any related fields.

## Research Interests

**Computer Architecture:** GPUs, Application Specific Architectures, Embedded Systems.

**Computer Graphics:** Rendering, Real Time Ray Tracing, Global Illumination, Video Games.

## Education

**University of Utah** Ph.D. Computer Engineering 2013

*Advisor:* Erik Brunvand

*Dissertation:* Efficient Ray Tracing Architectures

**University of California Riverside** B.S. Computer Engineering 2006

*Emphasis:* Embedded Systems

## Professional Experience

**Harvey Mudd College** Claremont, CA, USA

*Visiting Professor* July 2012 - Present

Taught courses in Digital Design, Parallel Computer Architecture, and Microprocessor and Embedded System Design. Advised research students in the area of computer architecture.

**NVIDIA** Santa Clara, CA, USA

*Research Intern/Consultant* June 2013 - Present

Power and performance modeling for future graphics hardware.

**University of Utah** Salt Lake City, UT, USA

*Graduate Research Assistant* June 2007 - August 2012

Developed a variety of architectures for real-time ray tracing, a cycle accurate simulator for performance studies, and a compiler back-end for the architectures.

*Teaching Assistant* August 2006 - May 2007

Assisted Dr. John Carter and Dr. Peter Shirley with courses in Operating Systems, Computer Graphics and Network Game Design.

**University of California, Riverside** Riverside, CA, USA

*Undergraduate Research Assistant* June 2005 - March 2006

Analyzed the performance of soft-core microprocessors on Xilinx FPGAs to develop tools for increased performance with reduced development effort. Advisor: Dr. Frank Vahid.

## Skills

**Languages :** C, C++, Python, SystemVerilog, VHDL, Assembly, Javascript.

**System simulators :** Simics, TRaX Simulator

**CAD Tools :** Cadence SOC Encounter, Virtuoso, Spectre; Synopsys Design Compiler; Altera Quartus II; Microchips MPLAB; Xilinx ISE, EDK

**Misc. :** LLVM, OpenGL, GLSL, Unity3D, PyOpenGL, Pyglet, SDL, Google App Engine, Django, MySQL, LATEX, Git, Subversion, Mac, Linux, Windows

## Refereed Publications

1. Daniel Kopta, Konstantin Shkurko, **Josef Spjut**, Erik Brunvand, and Al Davis; **Memory Considerations for Low Energy Ray Tracing**, *Computer Graphics Forum*, To Appear, 2014.
2. Daniel Kopta, Konstantin Shkurko, **Josef Spjut**, Erik Brunvand, and Al Davis; **An Energy and Bandwidth Efficient Ray Tracing Architecture**, *High-Performance Graphics (HPG 2013)*, Anaheim, July 10-21, 2013. [paper](#)
3. Daniel Kopta, Thiago Ize, **Josef Spjut**, Erik Brunvand, Al Davis and Andrew Kensler; **Fast, Effective BVH Updates for Animated Scenes**, *ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (I3D 2012)*, Irvine, March 2012. [paper](#)
4. **Josef Spjut**, Daniel Kopta, Erik Brunvand and Al Davis; **A Mobile Accelerator Architecture for Ray Tracing**, *3rd Workshop on SoCs, Heterogeneous Architectures and Workloads (SHAW-3)*, New Orleans, February 2012. [paper](#) [slides](#)
5. Daniel Kopta, **Josef Spjut**, Al Davis and Erik Brunvand; **Efficient MIMD Architectures for High-Performance Ray Tracing**, *IEEE International Conference on Computer Design (ICCD 2010)*, Amsterdam, October 2010. [paper](#)
6. Seth Pugsley, **Josef Spjut**, David Nellans and Rajeev Balasubramonian; **SWEL: Hardware Cache Coherence Protocols to Map Shared Data onto Shared Caches**, *19th International Conference on Parallel Architectures and Compilation Techniques (PACT-19)*, Vienna, September 2010.
7. **Josef Spjut**, Andrew Kensler, Daniel Kopta and Erik Brunvand; **TRaX: A Multicore Architecture for Real-Time Ray Tracing**, *IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems (TCAD)*, December 2009. [paper](#)
8. **Josef Spjut**, Andrew Kensler and Erik Brunvand; **Hardware-accelerated gradient noise for graphics**, *Proceedings of the 19th ACM Great Lakes Symposium on VLSI (GLSVLSI'09)*, Boston, May 10-12, 2009.
9. Niladrish Chatterjee, Seth Pugsley, **Josef Spjut** and Rajeev Balasubramonian; **Optimizing a Multi-Core Processor for Message-Passing Workloads**, *5th Workshop on Unique Chips and Systems (UCAS-5)*, Boston, April 2009.
10. **Josef Spjut**, Solomon Boulos, Daniel Kopta, Erik Brunvand and Spencer Kellis; **TRaX: A Multi-Threaded Architecture for Real-Time Ray Tracing** *Symposium on Application Specific Processors (SASP)*, Anaheim, June 8-9, 2008. (Best paper award) [paper](#)

## Tech Reports

1. Daniel Kopta, Andrew Kensler, Thiago Ize, **Josef Spjut**, Erik Brunvand, Al Davis; **Fast, Effective BVH Updates for Dynamic Ray-Traced Scenes Using Tree Rotations** *Tech Report, UUCS 11-002*, University of Utah, July 2011. [paper](#)

## Refereed Posters

1. Daniel Kopta, **Josef Spjut**, Erik Brunvand; **Grid-Based Ray Tracing for a Parallel Computing**

**Architecture**, *High Performance Graphics (HPG'09)*, New Orleans, August 1-3, 2009.

2. [Daniel Kopta](#), [Josef Spjut](#), [Erik Brunvand](#) and [Steven Parker](#); **Comparing Incoherent Ray Performance of TRaX vs. Manta**, *IEEE Symposium on Interactive Ray Tracing, 2008 (RT08)*, August 9-10, 2008.

## Research Students Advised

- Andrew Carter, HMC CS B.S. 2013 (at LinkedIn)
- Max Korbel, HMC Engineering B.S. 2013 (at Intel)
- Paula Ning, HMC Engineering B.S. 2013 (at Intel)
- Jingbin Yang, HMC Engineering B.S. 2015 (expected)
- Dong-hyeon Park, HMC Engineering B.S. 2014 (expected)
- Eric Storm, HMC Engineering B.S. 2015 (expected)
- Paul Jolly, HMC Engineering B.S. 2016 (expected)
- Fabiha Hannan, HMC Engineering B.S. 2016 (expected)
- Akhil Bagaria, HMC Engineering B.S. 2016 (expected)

## Funding and Donations

\$1440 FPGA Donation from Altera. July 2013.

\$2100 Microcontroller and Programmer Donation from Microchip. May-October 2013.

University Teaching Assistant Award. Fall 2010

## Awards and Honors

- Tau Beta Pi member since 2005
- University Teaching Assistant Award, Utah 2010-2011
- Best Paper Award, SASP 2008
- Chancellor's Scholarship, UCR 2000-2001
- University Honors Program, UCR 2000-2004

## Professional Activities

- Member, IEEE
- Member, ACM
- Reviewer, Computers and Graphics (CAG) 2013, 2012
- Reviewer, High Performance Graphics (HPG) 2012, 2011, 2009
- Reviewer, Transactions on Circuits and Systems (TCAS) 2010

## Teaching

- Digital Design and Computer Architecture; HMC E85; F2012, S2013, F2013, S2014
- Microprocessor Design; HMC E155; F2012, F2013
- Advanced Parallel Computer Architecture; HMC E1900 (new class); S2013
- Advanced Embedded Systems; HMC E190P (heavy revision); S2014
- Parallel Hardware Ray Tracing; Utah CS6965; F2011

As a teaching assistant:

- Kinetic Sculpture and Engineering; Utah CS5968/Art4455; F2010
- Introduction to Computer Graphics; Utah CS5600; S2007
- Network GameDesign; Utah CS59XX; S2007
- Operating Systems; Utah CS5460/6460; F2006

## Game Projects

### Wizard Fight Race

Led a group of four contributors in developing a game from scratch using the Unity game engine. This project was meant to see what a group of relatively inexperienced developers could do in comparison to other 72-hour game development projects that more well-established game developers participate in. (Executable downloads available at <https://sites.google.com/site/72hourgame/download>).

### PyGauntlet Open Source Game

PyGauntlet is a game project in Python from an undergraduate software engineering course where a group of 7 students developed a game over 8 weeks. After the course finished, I took over the lead of it and obtained permission to release the source code and continue development. I added an OpenGL based renderer to the engine and introduced engine optimizations to allow the game to run well even on slower processors. (Source code available at <http://code.google.com/p/pygauntlet/>).