Keith Jeffery

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Senior graphics engineer with 20+ years of experience developing high-performance rendering engines for film and real-time applications. Expert in C++, multi-threaded systems, adaptive sampling, and physically-based rendering. Proven track record of innovation with multiple patents and SIGGRAPH presentations.

EXPERIENCE

Polycam, Inc.   Glendale, California
Senior Software Engineer – Engine, Graphics and Rendering   *January 2024 - Current*

Polycam creates software that captures and manipulates 3D environments on mobile devices.

- Created a custom bounding-volume hierarchy to work with Gaussian splats and 3D meshes, optimizing build times for mobile platforms
- Implemented hierarchical constraint-based 3D snapping for linear and area measuring, including alignment to world axes, world planes, user-specified angles, arbitrary planes, mesh vertices, and measurement vertices
- Improved the real-time 3D rendering, including improved anti-aliasing, high-dynamic range lighting, and tone-mapping
- Created a tool to place comments in 3D environments
- Created a tool to measure the volume of 3D objects
- Implemented a real-time system to declutter measurement labels by displaying only the most important from visually overlapping labels

DreamWorks Animation   Glendale, California
Senior Software Engineer – Graphics and Rendering   *September 2017 - December 2023*
Software Engineer – Graphics and Rendering   *May 2012 - September 2017*

DreamWorks Animation creates animated feature films, television shows, and other entertainment media. As a 3D graphics rendering engineer, I added features through maintainable code and design pattern best practices while providing enhancements requested for feature film production for the REYES and the Monte Carlo ray tracing renderers.

- Researched and implemented leading techniques in adaptive sampling
  - Presented at DigiPro for novel firefly detection and removal
  - Awarded a patent for novel firefly detection and removal
  - Presented at SIGGRAPH on advancements in adaptive sampling
- Awarded a patent for a lock-free multi-producer/multi-consumer ring buffer
- Designed a barrier-free, thread-safe global hierarchy for adaptive sampling to minimize artifacts, reducing rendering time interactively and on the render farm
- Created a lock-free, dynamically load-balancing thread scheduler for rendering tiles
- Mentored interns in areas such as de-noising, machine learning, and general Monte Carlo ray tracing tasks
- Gave talks to DreamWorks Animation Research and Development department on C++ features and best practices
- Created the thread-safe, deterministic, vectorized Monte Carlo sampling suite, including quasi-Monte Carlo methods and innovative progressive Monte Carlo methods
- Designed the public API for geometry shaders for the Monte Carlo renderer
- Researched, designed, and implemented post-process de-noising algorithms
- Mentored interns in general Monte Carlo ray tracing tasks

Chief Architect, Inc. Coeur d'Alene, Idaho
Software Engineer *January 2006 - May 2012*

Chief Architect, Inc. is a leading developer of home design software for both the professional and home enthusiast. Added new features to the commercial software.

- Wrote the physically-based, parallel, SIMD-enhanced ray tracing engine from the ground up, including direct lighting, path tracing, bidirectional path tracing, photon mapping, and progressive photon mapping
- Moved the OpenGL rendering engine to modern techniques by removing the fixed-function pipeline and replacing it with physically-based shaders that performed lighting at the fragment level
- Implemented non-photorealistic rendering techniques, including hand-drawn lines, watercolor, and painting effects
- Conducted initial design for scene graph for real-time rendering engine
- Organized a lecture series for the development team, including speaking on C++, the Boost libraries, threading, and design patterns

University of Idaho, Computer Science Department Moscow, Idaho
Computer Science Instructor *Fall 2005*

Taught computer science students the C++ programming language, while also teaching critical thinking and design skills

Chief Architect, Inc. Coeur d'Alene, Idaho
Software Engineering Intern *Summer 2004 and 2005*

- Added new capabilities to the next release of their professional home design software package, Chief Architect, as a C++ developer
- Wrote applications to improve in-house testing and content management

University of Idaho, Computer Science Department Moscow, Idaho
Computer Science Laboratory Instructor *Fall 2004 and Spring 2005*

Taught students the basics of computer science through laboratory activities

Idaho National Laboratory Idaho Falls, Idaho
Software Engineering Intern *Summer 2002 and 2003*

The INL is a multipurpose national laboratory delivering science and engineering solutions to the world's environmental, energy, and security challenges. Position required government security clearance. Aided research in the field of real-time parallel visualization on Beowulf clusters by developing software tools using C, Python, Perl, and OpenGL.

- A Unix Domain Sockets network type for Stanford's Chromium rendering system
- A shared memory "network" type for Stanford's Chromium rendering system
- A parallel PLY model viewing application
- Viewport triangle clipping for custom geometry distribution application

Sky-Skan, Inc. Nashua, New Hampshire
Software Engineering and Content Development Intern *Summer 2001*

Sky-Skan develops media and hardware for planetariums worldwide.

- Wrote PHP and Perl applications to parse image information and then enter, retrieve, and modify the information in a MySQL database

- Created 3D computer models and wrote Maxscript applications

Tigar Hare Studios   Sherman Oaks, California
3D Technical Director   *June 1999 - December 2000*

Tigar Hare Studios created 3D animation and special effects for feature films, commercials, games, and special venue projects. Modeled, animated, textured, and lit 3D scenes and elements. Created final shot composites and wrote Maxscript applications. Hired as a full-time employee upon successful completion of an internship.

- Modeled, scripted, animated, surfaced, and composited 3D elements for the *Mission Impossible II* title sequence
- Modeled, scripted, and surfaced 3D elements for effects shots on feature film *Driven*
- Modeled, scripted, animated, surfaced, and composited for a series of six commercials for Mattel Hot Wheels

EDUCATION **University of Idaho**   Moscow, Idaho
Master of Science in Computer Science

- Thesis: *The Design and Implementation of a Production-Quality Ray Tracer*

University of Idaho   Moscow, Idaho
Bachelor of Science in Computer Science, Math and Studio Art Minors

PATENTS AND PUBLICATIONS
- *Inter-Device Lock-Free Ring Buffer*
  United States Patent 11886343, Keith Jeffery, January 30, 2024
- *Firefly Detection Using a Plurality of Buffers*
  United States Patent 10755387, Keith Jeffery, August 25, 2020
- *Global Adaptive Sampling Hierarchies in Production Ray Tracing*
  SIGGRAPH, August 1, 2019
- *Firefly Detection with Half Buffers*
  DigiPro, August 11, 2018