

Tyler Bryce Nowicki

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See www.greycode.ca for information on my thesis topics, and course projects.

PhD of Mathematics

2008-Present

University of Waterloo
(GPA 86%)

- My goal is to identify and model the universal movement patterns of salient features in traditional animation.
- Validation methods include data size analysis, subcategory classification, correlation testing, and cross-validation.
- Additional projects include 3D reconstruction of line drawings, fractal systems, and artistic rendering.

Apple

2014 & 2015

Cupertino, California, USA

- Two internships on Apple's LLVM optimization team.
- LLVM loop optimizations, diagnostics, and hints.
- Feedback directed performance tuning.

Intel

2009-2013

Waterloo, Ontario, Canada

- Self-directed research into global illumination, volume rendering, computer vision, object recognition, and medical image registration.
- Scientific computing samples in TBB, OpenCL, and OpenMP.
- LLVM Code-gen optimizations for Intel architectures.

RapidMind

2007-2009

Waterloo, Ontario, Canada

- GPU-based real-time ray tracer for automotive rendering.
- Rendering consultant to Real-Time Technologies (RTT).
- Developed RMDB parallel programming library.

Masters of Science

2004-2007

University of Manitoba

- Photon-mapping with unbiased sampling.
- Irradiance hemisphere estimation using biquadratic.
- GPA 4.3 (96%).

BCS Honours

2000-2004

University of Manitoba

- Real-time rendering with bounding volumes and BSP trees.
- Minor in psychology.
- Dean's Honour List 2004.

Patent

Adaptive Multi-Grid Contrast Optical Flow, United States 20120301051, Nov 29, 2012.

Conference Presentation

Partitioning Trees for Fast 3D Rendering, Undergraduate honours project, SIAM-CSE, Orlando Florida, 2005.

PhD of Mathematics at University of Waterloo (2008-Present)

PhD Thesis - I examined the frame-to-frame speed at which different parts of an animated character, such as hands and feet, move along their trajectories between key-frames. By averaging over animators, features, styles, and eras I identified the underlying patterns: a correlation between average acceleration and jerk that, in part, governs speed. The analysis, which includes numerous statistical tests for inaccuracy and bias, confirms that speed is largely determined by the desired average acceleration between key-frames. Although many aspects of speed are idiosyncratic this research indicates that universal patterns exist and may be useful for further simplifying the control of animation.

Software Developer at Apple (2014)

LLVM Development – I added feedback-based performance tuning features to LLVM and Clang including vectorization diagnostics and the loop hint pragma to control loop vectorization. See blog post (<http://blog.lldvm.org/2014/11/loop-vectorization-diagnostics-and.html>).

Software Developer at Intel (2009-2013)

Global Illumination using Sparse Voxel Octrees – Investigated the use of cone tracing and sparse voxel octrees for gathering a single bounce of indirect illumination in real-time. Intel decided to close the Waterloo office before the project could be completed.

Volume renderer in a GLSL shader – Real-time demo for ray tracing a 3D volume, estimating the boundary of skin and bone, and render their surfaces.

Computer Vision Algorithms – Implement the SIFT feature extraction and feature matching algorithm and studied many others.

Adaptive Multi-Grid Contract Optical Flow – Co-inventor of the method for deformation image registration of 3D medical images applied to breast cancer detection.

Scientific Samples and Demos – Developed/porting parallel algorithms in TBB, OpenCL, OpenMP, and ArBB for bilateral image filter, Sobel operator, FFT, Kirchoff seismic migration, tomography reconstruction using filtered back-projection, CERN track-fitting, Floyd Warshall, bitonic sort, Black-Scholes, Mersenne twister, Mandelbrot, and others.

LLVM Development – Optimized LLVM for Intel architectures including adding latency information, implementing IR passes, and avoiding glass jaws such as micro-coded instructions. Evaluated with SPEC CPU 2000/2006, EEMBC 2.0, ISPC, and LLVM test suite.

Intel Awards – Department award for instruction scheduling for Intel Atom in LLVM

Array Building Blocks (ArBB) – Developed library to leverage multi-core and many-core architectures including Intel Xeon Phi.

Software Developer at Rapidmind (2007-2009)

Acquired by Intel in 2009

Real-Time Raytracer – Developed and optimized a real-time ray tracer for Real Time Technologies (RTT) using RMDP for automotive pre-visualization.

Block Motion Compensation – Optimized algorithm which is part of MPEG video encoding for a customer application using RMDP.

MultiCore Development Platform (RMDP) – Developed the frontend and optimized the GLSL backend for offloading computation onto the GPU.

Masters of Science University of Manitoba (2004-2007)

Global Illumination and Approximating Reflectance in Real-Time – My research demonstrated that a polynomial approximation of reflected light can be more accurate than a constant approximation and that the solution improves if surface oversampling due to proximity to a light source is prevented.

BCS Honours at University of Manitoba (2000-2004)

Partitioning Trees for Fast 3D Rendering - Investigated the use of the Binary Space Partition tree for fast 3D rendering using OpenGL. The results of this project were presented at the SIAM Conference on Computational Science & Engineering in Feb. 2005.

Proficiencies

I have used many technologies in my career; here are a few that come to mind.

Compilers/Lang. C/C++, R, Matlab

Libraries & File Format OpenGL, GLSL, OpenCL, CUDA, OpenMP, TBB, FFMPEG, libJPEG, libPNG, BMP, OBJ and MTL, Wav(PCM), and Ogg/Vorbis

Source Control GIT, SVN

Project-Management ReviewBoard, RTC, Agile, Scrum, Rally, Jira, Pulse, ClearQuest

Test Frameworks Lit-Tests, Google Test

Research Courses

Graphics - Aesthetics & Computer Graphics, Non-Photorealistic Rendering, Digital and Computational Photography, and Advanced Graphics

Math - Numerical Solutions of Partial Differential Equations, Sensitivity Analysis

Coding Theory – Error correcting codes, Cryptography

OS and Networks - Operating System Design and Implementation, Computer Networks

Hardware - Real-time Micro-Kernel for the Lego Mind Storm

AI - Multiagent Systems