# RONALD PERRY

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**EDUCATION**

Bucknell University
Bachelor of Science
Mathematics and Computer Science
GPA 3.85 (Magna Cum Laude)

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**SKILLS**

Software architecture, design, and implementation
Algorithm and API design, software engineering, implementation of core engines
Computer graphics, data compression, image processing, numerical analysis
Mathematical modeling, 2D and 3D rendering, font rasterization
Python, NumPy, PyTorch, TensorFlow, Keras, Machine Learning, Deep Learning
Developing deep learning models and algorithms for various applications
Conducting R&D to identify new opportunities for deep learning applications
Developing and deploying deep learning applications in production environments
Testing and validating deep learning models and algorithms
C, C++, JavaScript, LISP, Scheme, Erlang, Forth, PostScript, SQL, Pascal, FORTRAN
WIN32, Mac OS X Frameworks, Qt, OpenGL
Parallel programming using OpenMP, MPI, GPGPU, and GLSL
2901 bit slice microcode, Intel, Motorola, and ARM assembly language

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**EXPERIENCE**

**Weta FX**
Wellington, New Zealand, 3 years and ongoing
Principal Research Scientist

Conducted research in various domains of computer-generated imagery (CGI) to ultimately improve production quality and performance in movies. Applied both classical CGI methods and deep learning approaches to the challenges at hand. One major focus included the investigation of new approaches for representing textures, including the strategic and judicious use of neural implicit image-based representations (neural fields) with various embellishments combined in a novel way. Embellishments included: integrated super resolution, detail directed tiling of the image plane for fast decoding, meta-learning for fast encoding, alternative formulations such as coordinates to patches for faster and improved convergence, multiple self-attention units for better global comprehension, pixel shuffle deconvolution for upscaling, alternative activation functions for better representation power, hierarchical shifted windows with patches for better global comprehension, and computational components including CNNs and residual blocks for feature extraction and simplifying pass-through processing.

**61 Solutions, Disney Research, and The Foundry**
Cambridge, MA, 8 years (simultaneously performed with MERL)
Principal Scientist, Software Engineer

Conducted fundamental research on digital sketching and drawing techniques resulting in disruptive breakthrough technology. Crafted a core cross platform library in object-oriented ANSI C embodying the results of the research and developed one specific target full-featured sketching, drawing, and painting application called Mischief. Using a revolutionary new approach for representing strokes on paper, Mischief achieves unparalleled performance with uncompromising quality. Mischief uses a revolutionary new stroke representation that allows you to create detailed, textured artwork typical of pixel-based systems, such as Adobe Photoshop, with the artifact-free scalability of vector-based systems, such as Adobe Illustrator. By combining this new stroke representation with a novel approach for representing scalable textured paper with infinite detail, Mischief provides infinite zoom without pixelization artifacts. Other features include: new compression methods providing very small file sizes, unprecedented performance by exploiting the massive parallelism inherent in today's GPUs, infinite undo and redo, unprecedented zoom of 50 trillion to one, and customizable pencils, pens, and erasers.

Some product reviews follow:
ImagineFX says: *"It's mind-blowing stuff."* 5/5 stars
Creative Bloq says: *"Mischief is a superb choice for all creatives."* 8/10 stars
Fast Company says: *"Mischief is an inventive sketching app."*
ImagineFX says: *"While other programs slavishly adhere to the ancient rules of what art should be, Mischief rips it up and starts again."* 4/5 stars

**MERL: Mitsubishi Electric Research Laboratories**
Cambridge, MA, 23 years (simultaneously performed with Disney Research)
Distinguished Research Scientist

Conducted fundamental research in the area of computer graphics resulting in numerous publications, a comprehensive patent portfolio, and the development of several meticulously crafted software components which embody the results of the research targeted for specific application areas such as digital type and 3D modeling. Specific highlights of the research include: 1) Saffron: a new framework for representing and rendering type that has been incorporated into the Amazon Kindle and Adobe's Flash Player engine and Flash product suite with billions of instances in use today 2) The incorporation of Saffron into Monotype's Edge font and imaging software products for worldwide distribution to manufacturers and developers of embedded devices 3) A family of ASIC implementations of Saffron, which are used by various business units within Mitsubishi Electric and 4) Sapphire: a new framework for representing highly detailed 3D models with unprecedented performance. Sapphire enables very fast NC milling simulation, especially of free-form surfaces, with accuracy better than 1 micron, and very low memory requirements.

*Selected Publications*
Alan Sullivan, Huseyin Erdim, Ronald Perry, Sarah Frisken, "High Accuracy NC Milling Simulation Using Composite Adaptively Sampled Distance Fields", Computer-Aided Design Journal, Vol. 44, Issue 6, pp. 522-536, June 2012

"Proximity Cluster Trees", *Journal of Graphics Tools*, Volume 13, Number 1 (2008), Elena Jakubiak Hutchinson, Sarah F. Frisken, and Ronald N. Perry

"Interactive Shape Editing", *SIGGRAPH 2006 Course*, Organizers - Marc Alexa, Lecturers - Marie Paule Cani, Sarah Frisken, Ronald Perry, Steven Schkolne, Karan Singh, and Denis Zorin

"An Improved Representation for Stroke-based Fonts", *SIGGRAPH 2006 Conference Abstracts and Applications*, Elena J. Jakubiak, Ronald N. Perry, and Sarah F. Frisken

"Molecular Morphing", *American Scientist*, September 2006, Felice Frankel, Ronald Perry, and Sarah Frisken

"Designing with Distance Fields", *International Conference on Shape Modeling and Applications*, June 15 - 17, 2005, Sarah F. Frisken and Ronald N. Perry

"Theory and Applied Computing: Observations and Anecdotes", *29th International Symposium on Mathematical Foundations of Computer Science*, August 22 - 27, 2004, M. Brand, S. Frisken, N. Lesh, J. Marks, D. Nikovski, R. Perry, J. Yedidia

"Simple and Efficient Traversal Methods for Quadtrees and Octrees", *Journal of Graphics Tools*, Volume 7, Number 3 (2002), Sarah F. Frisken and Ronald N. Perry

"Efficient Estimation of 3D Euclidean Distance Fields from 2D Range Images", *IEEE/SIGGRAPH Symposium on Volume Visualization and Graphics 2002*, Sarah F. Frisken and Ronald N. Perry

"Kizamu: A System for Sculpting Digital Characters", *SIGGRAPH 2001 Conference Proceedings*, Ronald N. Perry and Sarah F. Frisken

"Computing 3D Geometry Directly from Range Images", *SIGGRAPH 2001 Conference Abstracts and Applications*, Sarah F. Frisken and Ronald N. Perry

"A Computationally Efficient Framework for Modeling Soft Body Impact", *SIGGRAPH 2001 Conference Abstracts and Applications*, Sarah F. Frisken and Ronald N. Perry

"Dynamic Meshing Using Adaptively Sampled Distance Fields", *SIGGRAPH 2001 Conference Abstracts and Applications*, Jackson Pope, Sarah F. Frisken, and Ronald N. Perry

"A New Method for Numerical Constrained Optimization", *SIGGRAPH 2001 Conference Abstracts and Applications*, Ronald N. Perry

"Shadermaps: A Method for Accelerating Procedural Shading", *SIGGRAPH 2001 Conference Abstracts and Applications*, Thouis R. Jones, Ronald Perry, and Michael Callahan

"New Directions in Shape Representations", *SIGGRAPH 2001 Course*, Organizers - Hanspeter Pfister and Alyn Rockwood, Lecturers - Sarah Frisken, Ronald Perry, Hanspeter Pfister, Markus Gross, Leonard McMillan, Henry Moreton, Alyn Rockwood, Wim Sweldens

"Adaptively Sampled Distance Fields: A General Representation of Shape for Computer Graphics", *SIGGRAPH 2000 Conference Proceedings*, Sarah F. Frisken, Ronald N. Perry, Alyn P. Rockwood, and Thouis R. Jones

"Antialiasing with Line Samples", *Eurograhics Rendering Workshop 2000*, Thouis R. Jones and Ronald N. Perry

"Feline: Fast Elliptical Lines for Anisotropic Texture Mapping", *SIGGRAPH 1999 Conference Proceedings*, Joel McCormack, Ronald Perry, Keith I. Farkas, and Norman P. Jouppi

### Issued and Pending Patents – Rendering and Interaction
Improved Techniques for Anisotropic Texture Mapping Using Multiple Space-Invariant Filtering Operations Per Pixel, Ronald Perry, Joel McCormack, Norman Jouppi, and Keith Farkas

Anti-Aliasing with Line Samples, Thouis Jones and Ronald Perry

Method and Apparatus for Multi-Phase Rendering, Richard Waters, Ronald Perry, Thouis Jones, and Larry Seiler

Game Playing with Individual Anonymous Laser Pointers, Thouis Jones and Ronald Perry

Enhancing Textured Range Images Using a 2D Editor, Ronald Perry and Sarah Frisken

Single Lens 3D Camera, Ronald Perry and Sarah Frisken

### Issued and Pending Patents – Optimization
Method for Optimizing a Continuous Complex System Using a Set of Vertices and Dynamic Hierarchical Constraints, Ronald Perry

Method for Dynamic Constraint Handling in Vertex Based Optimization of a Continuous Complex System, Ronald Perry

Method for Optimizing a Continuous Complex System by Dynamically Partitioning Performances into Hierarchical Levels, Ronald Perry

### Issued and Pending Patents – General Computing
Continuous Memoization, Ronald Perry and Thouis Jones

Pipeline and Cache for Processing Data Progressively, Ronald Perry and Sarah Frisken

### Issued and Pending Patents – Adaptively Sampled Distance Fields

A Method for Estimating Volumetric Distance Maps from 2D depth images, Sarah Frisken and Ronald Perry

Detail-Directed Hierarchical Distance Fields, Sarah Frisken, Ronald Perry, and Thouis Jones

Sculpting Objects Using Detail-Directed Hierarchical Distance Fields, Sarah Frisken, Ronald Perry, and Thouis Jones

Representing A Color Gamut with a Hierarchical Distance Field, Ronald Perry, Sarah Frisken, and Thouis Jones

Customized Model Construction via a Network Interface, Ronald Perry, Sarah Frisken, and Thouis Jones

System and Method for Modeling Graphics Objects, Ronald Perry, Sarah Frisken, and Jackson Pope

Modeling Graphics Objects with Topological Hints, Ronald Perry, Sarah Frisken, and Jackson Pope

Modeling and Combining Multiple Graphics Objects, Ronald Perry and Sarah Frisken

System and Method for Generating Adaptively Sampled Distance Fields with Bounded Distance Trees, Ronald Perry and Sarah Frisken

Surface Following Interaction Method for Adaptively Sampled Distance Fields, Ronald Perry and Sarah Frisken

Distance Based Constraints for Adaptively Sampled Distance Fields, Ronald Perry and Sarah Frisken

Hierarchical Control Point Editing of Adaptively Sampled Distance Fields, Sarah Frisken and Ronald Perry

System and Method for Sculpting Digital Models, Ronald Perry and Sarah Frisken

System and Method for Converting Range Data to 3D Models, Sarah Frisken and Ronald Perry

Conversion of Adaptively Sampled Distance Fields to Triangles, Sarah Frisken and Ronald Perry

Method for Correcting an Adaptively Sampled Distance Field, Ronald Perry and Sarah Frisken

Method for Selectively Regenerating an Adaptively Sampled Distance Field, Ronald Perry and Sarah Frisken

Method and System for Dynamically Generating View Dependent Rendering Elements from a Static Adaptively Sampled Distance Field, Jackson Pope, Sarah Frisken, and Ronald Perry

Method For Generating Detail Directed Visibility Elements for a Graphics Model, Ronald Perry, Sarah Frisken, and Jackson Pope

Method and System for Modeling Interaction of Objects, Sarah Frisken and Ronald Perry

Method for Determining the Shape of Objects Directly from Range Images, Sarah Frisken and Ronald Perry

Method for Determining Distances to a Surface from a Range Image, Sarah Frisken and Ronald Perry

Method for Generating a Textured Range Image, Sarah Frisken and Ronald Perry

Method for Traversing Quadtrees, Octrees, and N-Dimensional Bi-trees, Sarah Frisken and Ronald Perry

Method and System for Rendering 3D Distance Fields, Alan Sullivan, Ronald N. Perry, and Sarah F. Frisken

Method for Embedding Messages into Documents Using Distance Fields, Shantanu Rane, Ronald N. Perry, Avinash Varna, and Anthony Vetro

Method for Simulating NC Milling using Adaptively Sampled Distance Fields, Sarah F. Frisken, Ronald N. Perry, and Alan Sullivan

Method for Reconstructing a Distance Field of a Swept Volume at a Sample Point, Sarah F. Frisken, Ronald N. Perry, and Alan Sullivan

Systems and Methods for Image Transformation, Ronald N. Perry

Systems and Methods for Image Transformation based on API Calls, Ronald N. Perry

Systems and Methods for Image Transformation based on Transformation Instructions, Ronald N. Perry

***Issued and Pending Patents – Digital Type (Fonts)***
Method for Antialiasing an Object Represented as a Two-Dimensional Distance Field in Image-Order, Ronald Perry and Sarah Frisken

Method for Antialiasing an Object Represented as a Two-Dimensional Distance Field in Object-Order, Sarah Frisken and Ronald Perry

Method for Animating Two-Dimensional Objects, Sarah Frisken and Ronald Perry

Method for Converting Two-Dimensional Objects to Distance Fields, Ronald Perry and Sarah Frisken

Method for Converting a Two-Dimensional Distance Field to a Set of Boundary Descriptors, Sarah Frisken and Ronald Perry

Method for Converting Two-Dimensional Pen Strokes to Distance Fields, Ronald Perry and Sarah Frisken

Method for Generating a Two-Dimensional Distance Field within a Cell Associated with a Corner of a Two-Dimensional Object, Ronald Perry and Sarah Frisken

Method and Apparatus for Antialiasing a Set of Objects Represented as a Set of Two-Dimensional Distance Fields in Image-Order, Ronald Perry and Sarah Frisken

Method and Apparatus for Antialiasing a Set of Objects Represented as a Set of Two-Dimensional Distance Fields in Object-Order, Sarah Frisken and Ronald Perry

Method for Generating a Composite Glyph and Rendering a Region of the Composite Glyph in Image-Order, Ronald Perry and Sarah Frisken

Method for Generating a Composite Glyph and Rendering a Region of the Composite Glyph in Object-Order, Sarah Frisken and Ronald Perry

Methods for Generating an Adaptively Sampled Distance Field of an Object with Specialized Cells, Sarah Frisken and Ronald Perry

Method and Apparatus for Rendering Cell-Based Distance Fields Using Texture Mapping, Ronald Perry and Sarah Frisken

Method for Typesetting a Set of Glyphs Represented as a Set of Two-Dimensional Distance Fields, Sarah Frisken and Ronald Perry

Method, Apparatus, and System for Rendering Using a Progressive Cache, Ronald Perry and Sarah Frisken

Method for Generating a Distance Field of an Object Represented by Outlines, Ronald N. Perry and Sarah F. Frisken

Method for Generating a Distance Field of an Object Represented by Stylized Strokes, Ronald N. Perry and Sarah F. Frisken

Method for Converting Glyph Outlines to Stylized Stroke Fonts, Elena J. Jakubiak-Hutchinson, Ronald N. Perry, and Sarah F. Frisken

Method for Improving Glyph Strokes Using Multiple Alignment Zones, Ronald Perry and Eric Chan

Method for Improving Glyph Outlines Using Multiple Alignment Zones, Ronald Perry and Eric Chan

Method for Converting Paths Defined by a Nonzero Winding Rule, Elena J. Jakubiak and Ronald N. Perry

Method for Labeling Segments of Paths as Interior or Exterior, Elena J. Jakubiak and Ronald N. Perry

Method for Rendering Paths without Aliasing Artifacts, Ronald N. Perry and Elena J. Jakubiak

Method for Rendering Paths without Outlining Artifacts, Ronald N. Perry and Elena J. Jakubiak

***Software and Hardware Components***
Responsible for the definition, architecture, design, and implementation of a new scene graph and display management system, called HPV, used in a prototype system for simulation and training in arthroscopic knee surgery. HPV is a comprehensive programming interface for developers creating real-time visual simulation and other performance-oriented 3D graphics applications. It simplifies development of complex applications used for visual simulation, simulation-based design, virtual reality, interactive entertainment, architectural walk-through, and computer aided design. Features include: An extensive set of objects, such as Windows, Scenes, Lights, Cameras, Actors, and Events, for building interactive applications • Volume and surface rendering • Direct support for haptic rendering and an API for performing physics • Multi-resolution actor description • Procedural generation of textures, shapes, and volumes for stock actors • An efficient memory management system to support adding and subtracting actor material • Utility objects for lists, stacks, queues, sets, vectors, matrices, transformations, splines, interval and affine arithmetic, etc. • Scheduling mechanisms for deformation and rendering • Tokenizer for parsing files • Persistent actor format • OpenGL encapsulation and renderer • Faster, smaller, and more focused than SGI's *OpenGL Performer* • Developed with object-oriented ANSI C • Runs under Windows 95, NT, 2000, Vista, Windows 7, and X11.

Contributed to the definition, architecture, design, and implementation of a comprehensive library incorporating the results of the Adaptively Sampled Distance Field research. Features include: Stock distance functions for constructing and combining objects • Milling specific distance functions for extrusion, surface of revolution, and lathing • Lofting between arbitrary 2D cross sections defined along a set of skeletal curves • Bezier clipping engine for computing minimum distance and determining ray-surface intersections • Tiled generation • Bounded-surface generation • Interactive CSG editing • Bezier tool paths • Infinite undo and redo • ADF editing history • Pressure sensitive pen support • Surface and volume rendering • Procedural shading interface • Adaptive, asynchronous ray casting with space leaping • ADF specific 2D antialiasing • Supersampling for standard 2D and 3D antialiasing • Simple

camera and lighting model • Region rendering to support interactive CSG editing • EPS to ADF conversion • Conversion of range data to ADFs • Idle time processing • Reconstruction functions • Bilinear, trilinear, and higher order ADFs • ADF read and write operations • Interactive generation of view-dependent and view-independent point models • Interactive generation of optimal triangle meshes • Generation of level-of-detail triangle meshes • Blending of ADFs • Input and output of Wavefront Object files • Amenable to parallel implementations • Developed with object-oriented ANSI C • Runs under Windows and Linux.

Contributed to the definition, architecture, design, and implementation of Kizamu – a computer-based sculpting system for creating digital characters for the entertainment industry. Collaborated with Visual Effects Supervisor Joe Letteri from Industrial Light and Magic to define the requirements, goals, and priorities of the project. See the SIGGRAPH 2001 paper for a description of the system. Kizamu incorporates both the ADF library and the HPV display management system described above.

Contributed to the definition, architecture, design, and implementation of a new framework for representing, rendering, and editing highly detailed 3D models. This framework, entitled Sapphire, is based on Adaptively Sampled Distance Fields (ADFs). For details see "High accuracy NC milling simulation using composite adaptively sampled distance fields".

Contributed to the definition, architecture, design, and implementation of a new framework for representing, rendering, editing, and animating character glyphs. This framework, entitled Saffron, is based on Adaptively Sampled Distance Fields (ADFs), which provide an ideal computational substrate for performing these operations. Features of Saffron include: Highly legible scalable type even at very small font sizes without the use of labor intensive manual hinting • Unparalleled adaptability for flat panel display technologies including new materials such as OLED • Continuous Stroke Modulation (CSM) which provides interactive user tuning of type for enhanced viewing comfort and personal preference • Automatic input from existing legacy fonts in OpenType, Type 1, and TrueType formats • Full support for rendering compressed stroke fonts • Automatic high quality outline-based and stroke-based Chinese-Japanese-Korean (CJK) rendering • New anti-aliasing methods which exploit the distance field to achieve superior rendering quality and speed for both static and animated type • Computationally clean rendering pipeline straightforward to implement in silicon • An automatic hinting strategy which mitigates the labor-intensive manual hinting process of current methods • LCD rendering which exploits the addressable colored sub-pixels of LCDs to increase the effective resolution of the display • OpenMP and GPU implementations • Developed with object-oriented ANSI C

Contributed to the design and implementation of two ASIC implementations of the Saffron technology. The first implementation is based on special cell ADFs and is compatible with the Flash 8 version of Saffron. The second implementation is based on the Saffron architecture developed specifically for embedded devices such as mobile phones.

Contributed to the definition, architecture, design, and implementation of the Saffron CSM Tuner. The Saffron CSM Tuner is a cross-platform software program that lets Flash authors optimize the appearance of typefaces rendered using the Saffron Type System. Saffron renders typefaces using a set of Continuous Stroke Modulation (CSM) parameters. The CSM Tuner provides an interface for adjusting these CSM parameters and viewing the results in real-time. Authors can optimize a typeface's appearance for individual point sizes and for different display configurations. The CSM Tuner was developed with FLTK, C++, and object-oriented ANSI C.

Contributed to the definition, architecture, design, and implementation of a new framework for asymmetric font compression. Distinguishing features over the prior art include random access to any glyph in a font and support for both stroke-based and outline-based representations. Developed with object-oriented ANSI C.

Contributed to the definition, architecture, design, and implementation of a new software engine for computing Constructive Solid Geometry (CSG) operations on 2D shapes. Distinguishing features of the engine over the prior art include (1) support for

non-linear Bezier edges (most algorithms work on polygons with linear edges), (2) difficult grazing conditions and singularities (e.g., coincident points and segments) are gracefully handled, (3) oriented edges (edges with direction) are supported, (4) it's 10-100X faster, (5) only integer arithmetic is used, and (6) it's API is simple. Developed with object-oriented ANSI C.

Contributed to the definition of *ESCape* (Entertainment System on a Chip) – a proposed handheld gaming system. Prototype sketches and storyboards were developed. A bit-accurate FELINE implementation was built, along with several other components such as a SIMD engine for procedural shading, a convolution engine for image processing, and software implementations of both line sampling and Shadermaps.

*Awards*
MERL President's Award: 2009
MERL Directors' Award: 2012
MERL Impact Award: 2004, 2005, 2009, 2010, 2011, 2012, 2015
MELCO R&D Award: 2008, 2009, 2012

*Other manifestations of the research*
Film Credit – Provided several animation sequences and still frames of artistically rendered molecular conformations and molecular reactions for a NOVA documentary "The Search for a Safe Cigarette" produced by Carl Charlson and debuting October 2, 2001 (see www.pbs.org/wgbh/nova). 105,000 frames were rendered, requiring 50M GFLOPS. A parallel implementation of the ADF library targeted for a Beowulf cluster using MPI was developed and employed. The molecules, represented as ADFs, were volumetrically rendered and procedurally shaded to provide the desired effect. Seen in more than 100 countries, NOVA is the most watched science TV series in the world and the most watched documentary series on PBS. It is also one of television's most acclaimed series, having won every major television award, most of them many times over. NOVA documentaries attract 8.5 million viewers, on average, in the US alone.

Art Exhibit – Presented ADF volumetric and geometric detail images at the art exhibit opening May 16th, 2003 at the New Center for Art & Technology and the New Media Art Gallery in Cleveland, Ohio. This work will also be shown at the Intel-sponsored Science & Engineering Expo May 11-17, 2003.

Published ADF Art – Three ADF volumetric molecular renderings were selected for both the front and back covers of the SIGGRAPH quarterly journal (Computer Graphics, Feb 2002).

Concept models for "Lord of the Rings" – Invited to develop ADF based geometric models to be used in the "Lord of the Rings" movie trilogy directed by Peter Jackson. Used Kizamu and developed new image-based methods to construct 3D models for Middle-earth and the Ents.

NSF Research Grant Proposal (NSF 01-149) "Sample-Based Modeling in Computer Graphics". Principal Investigators: Leonard McMillan, Steven Gortler, Julie Dorsey, Jovan Popovic, William Freeman. Research Collaborators: Hanspeter Pfister, Sarah Frisken, Michael F. Cohen, Hugues Hoppe, and Ronald Perry.

ADF Evangelism – "A Closer Look at Distance Fields", Computer Graphics World: Innovation in Visual Computing (www.cgw.com), December 2000

SIGGRAPH 2000 Art Gallery submission entitled "Desiderata" – an artistic display of the molecular conformations of our vices (e.g., nicotine, alcohol, and cocaine)

*Professional Activitities*
SIGGRAPH / Eurographics Graphics Hardware Workshop Program Committee 2000–2005; paper reviewer for ACM Transactions on Graphics (2002), SIGGRAPH (2000–2015), Journal of Graphics Tools (2003, 2005), Eurographics (2002), Visualization (1999–2000), and the Hardware Workshop (1999)

**Digital Equipment Corporation**
Maynard, MA, 2 ½ years

Consulting Engineer (contract position)

Contributed to the design and development of a 3D graphics rendering chip, called NEON, to support the next generation Alpha CPU. Responsible for the bit-accurate modeling of all aspects of the texture mapping hardware in software; this "software model" is used by application, graphics, and system engineers to develop all supporting software (e.g., OpenGL and DirectDraw). 1D, 2D, and 3D texture mapping with perspective correction, bilinear filtering, trilinear mipmapping, convolution, colorspace conversion, and pixel/texel transformations are supported. Additional rasterization code was written for conformant Win32 and X11 thin and wide lines, OpenGL antialiased lines, and OpenGL antialiased points. Contributions to the chip design and the OpenGL rendering library were made throughout the development process. OpenGL with C++ and C were used to drive and test the model under Unix and Windows NT; MS Visual C++ was the primary development tool.

Design and prototype development of advanced rendering algorithms to be incorporated into a future release of NEON: space-variant anisotropic filtering to improve the image quality of texture mapped surfaces, quadratic shading, full scene antialiasing via indexed sparse supersampling, and support for rendering directly from compressed texture maps. Numerous modifications were made to our OpenGL implementation to support the new algorithms.

**Quark**
Denver, CO, 1 ½ years
Consulting Engineer (contract position)

Responsible for the definition, architecture, design, and implementation of a new color engine targeted for XPress 4.0 and other Quark products. This engine defines how color is represented, displayed, transformed, and printed from within an application. ColorSync 2.0 and ICC profiles are supported. A set of color correction methods were developed for image editing: selective color correction, adaptive unsharp masking, tone and cast editing, histogram and endpoint processing. A CMYK to RGB mathematical model was developed to permit the efficient display of CMYK images. ICC profile editing, including GCR, dot gain, and subjective cast adjustments, was investigated and designed.

A detailed human interface specification for color within XPosure, a new image editing product for the Macintosh, was developed. The process involved an extensive survey of competitive products, user studies, and prototype development.

Two mathematical models were constructed to support GCR editing for a specific CMYK device and the efficient display of CMYK images. A numerical processing engine was developed to dynamically determine the parameters to each model. Nonlinear regression and inversion were the fundamental components to the engine. MATLAB and other numerical tools were employed off-line to aid in the initial analysis.

**Eastman Kodak, Color Science Group**
Billerica, MA, 2 years
Consulting Engineer (contract position)

Contributed to the design and development of the Microsoft Image Color Management (ICM) API for the Windows NT and Windows 95 operating systems. The ICM API defines how color is managed across scanners, monitors, digital cameras, and printers. Responsible for the development of various components of the Kodak color management module (CMM), the default CMM for ICM. The Kodak CMM is also used by Adobe Photoshop and Adobe Illustrator to consistently transform color information across different devices.

Responsible for the design and development of a set of PageMaker Additions and Quark XTensions incorporating the Kodak Color Management System. Features include: Source tagging, placement, and monitor correction of RGB and CMYK images • Display simulation for a specific output device • Color correction of images and spot colors for output • XYZ tagging of named color spaces • Efficient batch color separation • PhotoCD

support • Cross platform implementation for Windows 3.1 and Macintosh OS using Microsoft C 7.0 and THINK C

Conducted research in the area of numerical inversion. Designed and developed a globally convergent Newton-Raphson algorithm employed in various aspects of profile generation (e.g., gamut construction). Designed and developed an alternative inversion technique with guaranteed convergence. Interval arithmetic was used to insure robustness. Symantec C++ 6.0 and MATLAB 4.1 were used for development.

Conducted an extensive study of the Kodak output characterization process resulting in the definition and initial design of two ColorSync 2.0 profile editing tools.

**Eastman Kodak, Atex Business Unit**
Billerica, MA, 6 years
Consulting Engineer (contract position)

Engineering director, consulting architect, and co-developer of several key products and technologies that comprise the Atex portfolio.

Responsible for the design and development of an interactive display manager. Features include: Virtual drawing surfaces • Multiple views • Fast and quiet panning and zooming • Position independent rendering for various N-bit frame buffers. Renderable forms include lines, rectangles, conics, polygons, paths, text, and images • Position independent clipping to complex regions • Support for opaque and semitransparent raster operations • Antialiased grayscale rotatable and scalable text • Display hierarchy management • Fast and quiet damage detection and repair • Picking • Highlighting • Local object transformations for scaling and rotating text, structured graphics, and images • Locally optimized support of WYSIWYG text • Font management • Import of TIFF and Encapsulated PostScript • Initial support for Sun 3 and RS/6000 hardware (X-Windows)

Involved in the conception, design, and development of two Macintosh products: Replica, a structured graphics editor with some significant additions in the area of art generation and TextureMan, a sophisticated texture generation engine. Replica employs an iterated function system and a string rewriting component to permit very detailed drawings of objects and abstract backdrops to be generated. TextureMan permits the artificial evolution of textures and supports the PhotoShop plug-in architecture, enabling PhotoShop filters, such as sharpen and emboss, to extend the existing engine.

Responsible for the design and development of the Publishing Interchange Language (PIL), an emerging industry standard for document interchange. The PIL permits the interchange of publishing elements, such as stories and ads, between heterogeneous systems and applications. A C toolkit was co-developed with Quark for the generation, parsing, and semantic processing of the language.

Conducted research in the areas of shape representation and geometric processing for use within an editorial pagination system. Results included an efficient representation for screen renderable forms; this representation allowed for fast geometric processing (e.g., shape intersection and subtraction) and rendering.

Responsible for the design and development of a newspaper production tracking system for the Windows 3.0 platform. Borland C++ 2.0 was used in conjunction with C++/Views (an application framework).

Involved in the specification of the color requirements for the Editorial Pagination product family. Investigation of various technologies for performing color separations, trapping, and calibration was performed. An architecture describing how color flows through the Atex system was developed and implemented.

Involved in the conception and design of a Macintosh based fault tolerant OPI server featuring hardware support for image compression, color calibration, and image scaling. Configurable input and output queues allow efficient output processing.

Involved in the conception and design of a Macintosh and Windows based image browsing tool. SQL queries into the Atex Image Services database are supported.

Engineering manager for the Atex Fault Tolerant File Server (FTFS) and Fault Tolerant Database Server (FTDB). FTFS is comprised of dual Dell 486 processors with a proprietary 16-bit parallel interface between the primary and secondary machines. FTFS provides seamless and efficient NFS fault tolerance for several Atex products. FTDB provides a fault tolerant environment for the Sybase relational database.

**Computer Associates**
Bedford, MA, 1 year
Consulting Engineer (contract position)

Responsible for the design and development of a scripting language for a computer-based training package. An animation engine was a critical component of the runtime architecture. LEX and YACC were used to facilitate the development.

**Digital Equipment Corporation**
Maynard, MA, 2 years
Consulting Engineer (contract position)

Responsible for the design and development of a PostScript interpreter and rasterizer for various display and output devices. This project included the development of font hinting and scaling techniques to produce improved renditions of character outlines. In addition, the programmatic representation of bitmaps using a minimal set of bezier splines was investigated and implemented.

**Binary Renaissance Corporation**
Merrimack, NH, 5 years part time
Chief Executive Officer

Responsible for the design and development of an advanced mathematics product for the Apple Macintosh. Called Formula-1, the program provides engineers and applied mathematicians with a powerful and fast tool for numerical processing. Contributed to the development of the Binary Renaissance business plan. Responsible for obtaining two offers from Paracomp and Symantec for the sale and roll out of Formula-1 to the marketplace. Features include:

> *Plotting and graphics* - Two dimensional plots including function, data, contour, polar, parametric, and scatter • Structured graphics editor for the annotation of results • Three-dimensional function and data plotting • DRAW, a general-purpose graphics language supporting all of Quickdraw with several enhancements (e.g., splines and sophisticated object cloning) • A real time animation engine

> *Numerical Analysis* - Linear and nonlinear optimization, equation solving, and regression with support for constraints • Roots of a polynomial and of a function • Integration • Differentiation • Stiff ordinary differential equations • Matrix arithmetic, sorting, generation, inversion, trace, condition number, complex eigenvalues and eigenvectors, singular value and LU decompositions, and characteristic polynomial • Determinants • 1D and 2D Fast Fourier Transforms • An extensive special function library

> *Formula-1 Programming Language* - Support for simple variables, vectors, matrices, strings, functions, polynomials, linear equations, nonlinear equations, and differential equations • Programmatic constructs include assignment, looping, and conditionals

**Tegra**
Billerica, MA, 2 years
Consulting Engineer (contract position)

Responsible for the design and development of one- and two-dimensional compression techniques for bitonal images. All algorithms were implemented in C and 2901 microcode. In addition, the rasterization of Bitstream outlines was investigated and

then implemented. Features include electronic skewing, overstrike, x and y scaling, rotation, inverse video, right and wrong reading, and complex clipping. Special emphasis was placed on stroke weight maintenance, dropout control, and the elimination of baseline jitter. A font cache was implemented to enhance performance.

**XyVision**
Woburn, MA, 1 year
Consulting Engineer (contract position)

Responsible for the design and development of one- and two-dimensional compression techniques for bitonal images. Implemented rasterization algorithms for various geometric constructs. C, 68000 assembler, and 2901 microcode were used for development.

**IBM**
Sterling Forest / Yorktown Heights, NY, 2 years
Systems Programmer

Contributed to the development and maintenance of the VM/SP operating system. Coded, tested, debugged, and maintained various aspects of the OS, including scheduling, memory management, and interrupt processing.