William M. Bricken, Ph.D.

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Summary

- Creative, productive, responsive, meticulous -- specializing in team-oriented pragmatic solutions to challenging problems.
- Integrated understanding of software design and development, statistical and computational modeling and analysis, and instructional design and presentation.
- Outstanding technical management, leadership, and cross-functional problem solving in start-up, corporate, and academic environments. Respected and trusted technical leader and mentor.
- Eighteen years commercial software research and development experience, including fourteen years in high-productivity management positions with multiple concurrent objectives.
- Six years experience teaching graduate-level courses in software engineering, programming methods, computer interface techniques, and statistical analysis.
- Designed and implemented high performance, innovative algorithms in network optimization, Boolean reasoning, distributed virtual environments, and machine interaction.
- Innovative educator and curriculum designer with experience as a primary school principal, high school science teacher, college lecturer, and graduate school professor.
- Articulate technical and business writer, speaker and presenter, with extensive experience.

Formal Education

- Ph.D., Mathematical Methods of Research, School of Education, Stanford University.
  Multidisciplinary studies in Research Methodology, Computer Science, Artificial Intelligence and Educational Psychology. 1987
  Dissertation: Analyzing Errors in Elementary Mathematics.
  Advisors: Derek Sleeman, Ingram Olkin, Richard Snow, James Greeno.
- M.S., Statistics, Stanford University. Emphasis on measuring and analyzing human behavior.
- M.Ed. (candidate), Educational Innovation, La Trobe University, Melbourne, Australia.
  Thesis: Forming and Running a Co-operative School.
- Diploma of Education, Mathematics and Counseling, Monash Teachers College, Melbourne, Australia.
- B.A., Social Psychology, University of California at Los Angeles.
- A.A., Mathematics and Physical Sciences, El Camino College, Los Angeles.

Employment History

Chief Scientist and Co-founder

Bricken Technologies Corporation, Menlo Park, California 2000-2005

NETWORK OPTIMIZATION SOFTWARE for SEMICONDUCTOR DESIGN

- Provided technical leadership; wrote business plans, funding presentations, product specifications and development plans, technical reports. Raised $500,000 in venture funding.
- Conducted market research, product definition, and product differentiation studies.
- Designed and implemented innovative semiconductor design tools and algorithms for parsing, area optimization, delay optimization, partitioning, abstraction, technology mapping, and performance parameterization.
- Designed statistical and analytic techniques for evaluating the performance of optimization algorithms.
- Wrote over 20,000 lines of verified computer code, in a variety of languages, for manipulation, transformation and optimization of huge logic networks operating under timing constraints.
- Demonstrated world-class performance of combinational and sequential logic network optimization algorithms; demonstrated 15% improvement over existing commercial tools.

Assistant Professor of Computer Science and Software Engineering

Seattle University, Seattle, Washington 1996-2001

- Supervised the Master of Software Engineering program, including capstone (full year) software engineering project teams writing commercial software.
- Redesigned the Master of Software Engineering curriculum.
- Contributed to the design of curriculum, marketing, scholarship, and academic policies for Seattle University Graduate Programs; member of the Graduate Leadership Board.
- Graduate-level courses taught:

Discrete Mathematics	Applied Formal Methods
Artificial Intelligence	Computer Graphics
Human-Computer Interaction	Programming the Interface
Programming Methodology	Client/Server Architectures
Computer Ethics	Special Projects

Consultant (half-time, concurrent with academic appointments)

Interval Research Corporation, Palo Alto, California 1993-2000

FORMAL MODELS OF COMPUTATION, LOGIC SYNTHESIS, VISUAL LANGUAGES

- Contributed to the Natural Computing Project which focused on rebuilding computational theory and mechanism from first principles.
- Designed and implemented innovative algorithmic techniques for determining satisfiability; for

logic processing and optimization; for Boolean factoring and minimization; for computer arithmetic; and for asynchronous parallel computation.

- Designed and implemented a set-based predicate inference engine. Applied this engine to logic and rulebase minimization, to data mining, and to logic synthesis.
- Designed and implemented innovative algorithms for transformation and optimization of large logic networks, with world-class performance on the ISCAS'91/MCNC benchmarks.
- Invented several diagrammatic formal systems that provide parallel implementation models.

Chief Technology Officer

Virtual Express Ltd., Bellevue, Washington 1994

VIRTUAL REALITY PRODUCT IMPLEMENTATION, EXPERIENCE DESIGN

- Determined product design, features, constraints, development effort, and costs. Wrote business plans, negotiated with components suppliers, and managed office.
- Conducted market research and product acceptance studies and statistical analysis.
- Led technical team, established requirements, specifications and schedules for product build. Developed on-time and within budget a cost-effective commercial prototype immersive VR system for multiple participants with real-time interactive objects.

Research Associate Professor of Education and Research Associate Professor of Industrial Engineering (non-salaried)

University of Washington, Seattle, Washington 1992-1994

- Supervised graduate students in Educational Technology and in Industrial Engineering.
- Graduate-level courses taught:

  Human-Computer Interaction
  Virtual World Development
  Management Decision Models

Short Course Lecturer

Various 1991-1993

- Siggraph Tutorial, 1991: Virtual Interface
- UCLA Extension 3 Day Course, 1991: Virtual Interface Technology
- NCCE Tutorial, 1992: Virtual Reality for Education
- UCLA Extension 3 Day Course, 1992: Virtual Interface Technology
- Siggraph Tutorial, 1992: Developing Immersive Systems
- Visual Languages Tutorial, 1992: Language Aspects of VR
- UCLA Extension 3 Day Course, 1993: Virtual Interface Technology
- ACM-CSC Full day Tutorial, 1993: Virtual Reality and Experiential Computation

Principal Scientist

Human Interface Technology Laboratory,
Washington Technology Center, Seattle, Washington 1990-1994

ADVANCED HUMAN-COMPUTER INTERACTION, VIRTUAL REALITY SYSTEMS

- Designed the computational infrastructure of the research laboratory. Solicited, selected and supervised graduate students and summer students.
- Wrote and negotiated proposals resulting in over $3,000,000 of equipment and software grants.
- Developed innovative software tools for construction of, navigation in, and interaction with virtual environments. Responsible for concurrent software projects, including innovative concepts, management of the programming teams, and evaluation of software performance.
- Applied virtual reality tools to the design and evaluation of instructional environments.
- Contributed to the formation of several start-up companies. Served as a technology transfer agent between commercial organizations and the Washington Technology Center.

Principal investigator and primary designer for these projects:

- **Virtual Environment Operating Shell (VEOS)**
  Software infrastructure for construction of, maintenance of, and interaction with arbitrary virtual environments. This system features management of world databases using a Linda-like associative memory, modular software tools, automated linking and initialization of distributed processing resources and interface devices, and algebraic programming techniques. The entity-based programming metaphor provides operating system capability for each object/agent in the virtual world and unique contextual/environmental modeling tools. VEOS supports multiple participants, concurrent divergent worlds, modular agent programming, autonomous entities, voice recognition, real-time interactive editing, and distributed parallelism. Written in C and integrated with interface languages LISP, Mathematica, VOGL, and MIDI, for distributed UNIX processors. With G. Coco and ten other graduate students, two theses; 1989-93.
- **The Wand**
  A software tool for viewpoint control, object manipulation, and information gathering. This 3D evolution of the mouse emanates a ray in virtual space that is sensitive to collisions, perspective, and metrics. With one post-grad; 1990-93.
- **The Virtual Body**
  A software suite for associating arbitrary sensors of physical activity to arbitrary virtual entities. Includes a physiological model for calibrating the virtual world to the body of each participant, mapping tools for associating the physiological model with the functionality of inhabited entities, and perceptual filters for directing attention. With three graduate students, one thesis; 1990-93.
- **Educational Worlds**
  Development of pedagogical techniques which are embedded in the behavior of virtual entities. Development of process models of student learning and behavioral choice based in situated activity, constructivist philosophy, social learning, theories of multiple intelligences, and complete individualization of learning experiences. Studies of transfer of learning across

virtual, symbolic, and natural training experiences. With M. Bricken, Professor W. Winn and four graduate students, two dissertations; 1990-1996.

- **Semantics of Virtuality**
  Formal and philosophical investigations into the meaning of inclusion in virtual spaces, into natural and abstract representations, and into the form of virtuality. 1990-current.

- **Experiential Mathematics**
  Formal techniques for converting the representation and transformation of mathematics (logic, set theory, numbers, and algebra) into spatial, interactive, and experiential forms. Molecular computing models for set-based parallelism. Prototyped in VEOS and Mathematica. With two grad students, two theses; 1991-current.

- **Boeing Virtual CAD System (Protospace)**
  A software prototype workstation for constructing and managing virtual worlds for aeronautics applications. The VSX demo of Protospace was instrumental in the Boeing Company focusing on VR as a primary strategic objective. Trained the initial Boeing VR team. 1990-91.

- **VEOS Artificial Life**
  A systems-oriented programming approach to agent architectures. Every entity has the capabilities of an operating system and is executing a real-time sense-process-act cycle. Provides capabilities for autonomous agents, reactive and responsive planning, self-modification, adaptive sensing, and genetic evolution. With Santa Fe Institute; 1992-93.

- **VR Rapid Construction Modeler**
  Development of new techniques for construction of virtual worlds, based on L-systems, generalized sweeps, spatial enumeration, and form decomposition. With P. Oppenheimer; 1992-93.

- **Embedded Narrative**
  Exploration of dynamic computational theories of narrative, and the development of software tools for rhetoric that embed characterization, dramatic tension, and narrative structure into interactive virtual experiences. With Professor S. Sloane, University of Puget Sound Department of English; 1992-93.

- **Physical Dynamics**
  Incorporation of Newtonian dynamics into the virtual space. Focus on linear and sublinear algorithms for real-time interaction with dynamic objects. With one post-grad; 1993.

- **Consulted** on the use of virtual reality techniques for:
  -- communicating situation awareness in complex information environments,
  -- training for shipboard disaster management,
  -- data organization techniques for libraries,
  -- rapid construction of graphic models of cities,
  -- emergency vehicle operator training,
  -- physiology of stereographic imagery,
  -- communication techniques in cyberspace,
  -- constructability of office buildings,
  -- applications of immersion to CAD modeling of aerospace construction techniques,
  -- underwater imaging
  -- learning and instructional theory.

Director and Distinguished Fellow

Autodesk Research Laboratory, Autodesk Inc., Sausalito, California 1988-1989

COMPUTER-AIDED DESIGN, GRAPHICS LANGUAGES, GRAPHICS INTERFACE

- Responsible for corporate research; project plans, requirements, management and cohesiveness; software design, review and evaluation; technology presentations; and innovative concepts.
- Initiated, staffed and managed the Autodesk Research Laboratory. Conducted software design, development and evaluation, technology reviews, weekly forums, media liaison, business and conference presentations, and in-house consultation.

Developer of the following prototype systems:

- **Cyberspace**
  Project manager for the development of a computer graphics system that in 1988 provided "direct interaction with computer generated virtual environments by creating the impression of inclusion within a 3D graphical world, as if it were real." The team developed original interface hardware, software operating shells, construction tools based on AutoCAD, and virtual world designs and design techniques. In June, 1988, Cyberspace became the first commercially developed VR system to be made available for public use. Responsibilities:
  -- project planning, management, coordination and liaison
  -- demo design and coordination, and product prototype evaluation
  -- usability studies, performance analysis, protocol analysis and statistical evaluation
  -- technical reports, presentations and recommendations
  -- original research on hardware architecture, software design, and user cognition.
  With M. Bricken, E. Gullichsen, and several software engineers; 1988-89.
- **Algebra of Drawings**
  Designed and implemented an algebra that maps group theoretic concepts onto spatial concepts. The engine uses string rewrite theory on turtle graphics specifications to generate quantized drawings, fractals, graphtals, and form abstraction. Written in Mathematica. 1988.
- **Visual Programming Languages in Boundary Mathematics**
  These languages are based on formal maps between textual and spatial representations of logic, numbers, recursive functions, and databases. Syntactic evaluation and compilation of spatial expressions is achieved by topological transformations. Graph, map, pebble, bubble, path, rock-wall, and fish stream based programming models. 1987-88.

Principal Research Scientist

Advanced Decision Systems, Mountain View, California 1984-1988

ARTIFICIAL INTELLIGENCE, HUMAN-COMPUTER INTERACTION

- Responsible for project planning, management and reporting; funding proposals; technical leadership; innovative concepts; and large hunks of computer code.

Designed and contributed to the implementation of these prototype systems:

- **Verification, Optimization, Compilation, and Partitioning of Rule-bases**
  Identification of consistency, redundancy, and relevance in expert system knowledge-bases. Partially implemented. 1986-87.

- **Parallel Deduction**
  A fully local, asynchronous, fine-grained parallel model of propositional logic and deduction. Designed for control parallelism on the Connection Machine and implemented on the Intel Hypercube. Demonstrated at IJCAI'87. Written in LISP. 1986-87.

- **Boolean Minimization**
  Algebraic optimization of propositional expressions. Tautology identification an order of magnitude faster than the Boyer-Moore Theorem Prover while requiring less memory. The inference engine incorporates innovations in equational logic and pattern-matching heuristics. Versions written in Pure LISP, Prolog, and Scheme. 1984-86.

- **Boundary Numbers**
  Fine-grain parallel representation of rationals as topological networks. Theory developed in 1987, implemented in Mathematica and LISP in 1992.

- C**ontradiction Maintenance**
  Use of imaginary boundaries for inference in the presence of contradictory data. The system partitions a knowledge-base into consistent and inconsistent portions, reasoning with imaginary logic values (mapped from Kleene 3-valued logic) in place of contradictions that would terminate other inference techniques. Written in LISP. With P. Hadaway 1986.

- **Constraint Maintenance**
  Designed and implemented a unique constraint modeling system for Boeing that solved complex cockpit design problems by tightening the configuration space while maintaining a satisficing solution. 1985

- **Instructable Interface**
  Designed and implemented a prototype interface for complex databases. The interface developed a model of the query processes of the user, and learned to organize and explain data using the model.

- **Statistical Analysis Package**
  Designed and implemented a Categorical Analysis Toolkit as part of a behavior modeling workstation. The tool accessed data using a customized database query language, and provided hierarchical category organization, clustering, constraints and analysis based on classes, time-frames, scope of data request, and desired groupings for analysis. It provided a full range of descriptive statistics (both categorical and continuous) for attributes of categories, a two-dimensional plotter, goodness-of-fit tests, two-way categorical analysis, log-linear modeling, and time series models (autoregressive, moving average, ARIMA, intervention). 1984

- **Pictorial Language**
  Designed a formal pictorial language for querying databases of programs. Used for semantic optimization of Ada programs.

- **Consulted** on the uses of artificial intelligence techniques for
  -- maintenance training,
  -- cockpit design automation,
  -- naval capabilities assessment,
  -- distributed performance maintenance,
  -- intelligent tutoring systems.

Intern, Consultant and Wizard

Atari Research Laboratory, Sunnyvale, California 1983-1984

USER INTERFACE and MODELS

- Research into implementation of advanced user interfaces, user models, media rooms, fractal graphics, multimedia encyclopedias, and automated browsing of large pictorial databases.

Teaching and Research Associate

Stanford University, Stanford, California 1981-1984

- Full scholarship for two years, teaching associate for the following two years.
- *Dissertation research:* Empirically validated the unique nature of errors made by students learning algebra. Using a range of experimental techniques (multivariate experiment, exploratory factor analysis, protocol analysis, clinical case study, historical review, ontological deconstruction, and direct remediation), I demonstrated that symbolic errors made by novices are neither random nor predictable, rather they are context sensitive, situated, and unique. Both the structure and the randomness found in previous error studies are artifacts of experimental design and of simplifications projected by the experimenter or teacher. The implication for automated student modeling in intelligent tutoring systems is that algorithms cannot model novice error behavior, but can model behavioral tasks. The recommendation is that modeling should be constrained both to subject matter domains and to models of correct behavior.
- Graduate-level courses taught:

Computer-based Statistical Analysis	Statistical Analysis in Educational Research
Interactive Educational Technology	Intelligent Tutoring Systems

____ Selected Professional Activities 1990-1997 _____

Between 1984-89 and 2000-05, I worked in confidential and trade secret environments.

Boards and Committees

Associate Editor (1994-97) Presence: Teleoperators and Virtual Environments, MIT Press
AI Expert Editorial Board
Meckler International Directory of Virtual Reality Research and Development Editorial Board
National Science Foundation Board of Reviewers (virtual environments, experiential programming)
National Academy of Sciences Committee on Virtual Reality Research and Development
National Science Foundation Invitational Workshop on Research Directions in Virtual Reality
Executive Committee, IEEE Task Force on Multimedia Computing
Wavefront/Alias Academic Advisory Council
Siggraph 1991 Tomorrow's Realities Jury
IEEE 1992 International Workshop on Visual Languages Program Committee
IEEE 1993 Symposium on Research Frontiers in Virtual Reality Program Committee
IEEE 1993 Visualization Program Committee
IEEE 1993 Virtual Reality Annual International Symposium Program Committee
ACM 1994 Virtual Reality Systems and Technology Program Committee
ACM 1994 CHI Program Committee
Membership: ACM, Siggraph, IEEE, CHI, AAAI, CPSR

Public Addresses

German National AI Society'95	(keynote)	Distinction Networks
UW Education Colloquium'94	(keynote)	Student Errors Are Unique
World Computer Congress'94	(plenary)	Inclusive Computing
Complex Agent Architecture'94	(keynote)	Entity Modeling
Siggraph'94	(panel)	Graphics vs. Action
Siggraph'93	(panel)	VR Operating Systems
ICAT/VET'93	(plenary)	Experiential Computing
CyberArts'92	(plenary)	VRt
Visual Languages'92	(paper)	Spatial Representation of Algebra
CS and Philosophy'92	(keynote)	At the Boundary of Reality
NCCE'92	(keynote)	Virtual Reality in the Classroom
Imagina'92 Monaco	(keynote)	Progress in Virtual Reality
Meckler VR'91 California	(keynote)	Mathematical Foundations of Cyberspace
Meckler VR'91 London	(plenary)	VR Directions of Growth
Siggraph'90	(panel)	VR Hip, Hype, Hope
CPSR DIAC'90	(plenary)	VR: As Unreal as It Gets
NASA RIACS'90	(keynote)	A Vision of Virtual Reality

Publications

W. Bricken (1995) Distinction Networks. in I. Wachsmuth, C.R. Rollinger & W. Brauer (eds.) *KI-95: Advances in Artificial Intelligence*., Springer, 35-48.

W. Bricken and G. Coco (1995) VEOS: The Virtual Environment Operating Shell. in W. Barfield and T. Furness (eds.) *Virtual Environments and Advanced Interface Design*, Oxford U. Press.

W. Bricken (1994) Inclusive Symbolic Environments. in K. Duncan and K. Krueger (eds.) *Proceedings of the 13th World Computer Congress*, v3, Elsevier Science, 163-170.

W. Bricken and G. Coco (1994) The VEOS Project *Presence* v3(2), MIT Press, 111-129.

W. Bricken (Naoki Kobayashi and Sueki Matsumura trans.) (1993) Extended Abstract: A formal Foundation for Cyberspace. Intercommunication #3

K. M. Fairchild, T. Poston, and W. Bricken (1993) Efficient Virtual Collision Detection for Multiple Users in Large Virtual Spaces. *Proceedings of VRST'93,* 56-70.

W. Winn and W. Bricken (1992) Designing Virtual Worlds for Use in Mathematics Education: The Example of Experiential Algebra. *Educational Technology*, v32(12), 12-19.

W. Bricken (1992) Spatial Representation of Elementary Algebra, *1992 IEEE Workshop on Visual Languages*, Seattle, IEEE Computer Society Press, 56-62.

J. James and W. Bricken (1992) A Boundary Notation for Visual Mathematics, *1992 IEEE Workshop on Visual Languages*, Seattle, IEEE Computer Society Press, 267-269.

G. Bishop, W. Bricken, F. Brooks et al. (1992) Research Directions in Virtual Environments: Report of an NSF Invitational Workshop. *Computer Graphics*. 26(3): 153-177.

W. Bricken and L. Jacobson (1992) Virtual Environment Operating System, VR Special Report, 55-58.

W. Bricken (1992) Progress in Virtual Reality, *Proceedings of Imagina'92*, Monte Carlo, I25-40.

W. Bricken (1991) VEOS: preliminary functional architecture, *ACM Siggraph'91 Course Notes, Virtual Interface Technology*: 46-53.

W. Bricken (1991) A Formal Foundation for Cyberspace. *Proceedings of Virtual Reality '91,* San Francisco, Meckler, 9-37.

W. Bricken (1990) Virtual Reality: Directions of Growth. *Proceedings of Siggraph'90* VR panel.

W. Bricken (1990) Cyberspace 1999, *Mondo 2000*, Summer 1990, 56-59.

W. Bricken and E. Gullichsen (1989) An Introduction to Boundary Logic with the Losp Deductive Engine, *Future Computing Systems* 2(4), 1-77.

W. Bricken (1986) A Simple Space, *Proceedings of the Sign and Space Conference*, UC Santa Cruz.

W. Bricken and P. Nelson (1986) Pure LISP as a Network of Systems, *Proceedings of the Second Kansas Conference: Knowledge-Based Software Development*, Kansas State University.

W. Bricken (1973) Coonara Children's Community School, in H. P. Scheonheimer (ed.), *Good Australian Schools*, Technical Teachers Association, Melbourne Australia, 9-14.

Selected Proposals and Fund-Raising

Topic: A VR Home-Entertainment System
Role: Primary developer and technical lead
Status: to Polygram Records, $10M+, unsuccessful.

Topic: A Virtual World for Teaching Algebra
Role: Principal Investigator with Prof. W. Winn, UW School of Education
Status: to NSF, $856,000 over two years, discontinued.

Topic: A Study of a Virtual World Composing Community
Role: primary contributor with Dr. S. Sloane, University of Puget Sound
Status: to NEH, $150,000 over three years, successful with revisions

Topic: Virtual Environment Crisis Management System
Role: primary contributor for HITL
Status: to US Navy, $1.5M over three years, successful 1993.

Topic: Rapid Construction of Model Buildings
Role: Principal Investigator and sole author for HITL
Status: to UCF Institute of Simulation Training, $150,000 over two years, successful 1993.

Topic: Interactive Complex Systems Simulation
Role: primary technical contributor
Status: with Santa Fe Institute, $5M over three years, unsuccessful.

Topic: FiberSpace, VR in Education
Role: primary technical contributor for HITL
Status: to USWest, $500,000, successful 1991.

Topic: Constructability and Virtual Reality
Role: Principal Investigator with Dr. D. Reed, UW Civil Engineering
Status: to NSF, $458,000 over two years, unsuccessful.

Topic: ProtoSpace, VR-CAD for aircraft
Role: Principal Investigator and sole author
Status: to Boeing, $150,000, successful 1991.

Topic: Software donations
Role: sole negotiator
Status: to Mathematica, Autodesk, Wavefront, Alias, Division, and Franz LISP, $700,000, successful 1990.

Topic: Infrastructure for Virtual Environments
Role: sole author and negotiator
Status: to Digital Equipment Corporation, $1.7M over four years, successful 1990.

_____ Substantive Technical Reports 1983-2005 _____

Boundary Institute

2005: Notational Variety in Boundary Logic
2005: Boundary Logic and Alpha Existential Graphs
2005: Equality is Not Free
2005: Taking Nothing Seriously: A Foundational Diagrammatic Formalism
2005: What's the Difference: Contrasting Boundary and Boolean Algebras
2005: Fracturtles Revisited
2005: Website Construction: www.wbricken.com

Bricken Technologies Corporation — Presentations:

2004: Synthesis Applications of Boundary Logic
2004: BTC Board of Directors Technical Review (quarterly)
2002: BTC Company Overview
2002: BTC Investor Presentation
2002: BTC Marketing Presentation
2002: Comesh Technical Review
2002: Changing the Rules of Digital Design
2002: Comesh Progress Report
2002: BTC Product Design
2002: BTC Technical Design Review
2002: Technical Validation Project: Summary Report
2001: CM85A
2001: The Circuit Design Generator

Bricken Technologies Corporation — Corporate:

2004: BTC Business Model
2002: Corporate Executive Summary
2002: BTC FAQ
2002: BTC Corporate Overview
2001: BTC Product Strategy
2001: BTC Business Sketch

Bricken Technologies Corporation — Marketing:

2004: Boundary Mathematics Applications to Logic Synthesis: Empirical Results
2004: Iconic Tools Advance the State-of-the-Art
2004: Losp Synthesis System: Value Propositions
2003: Cell Libraries
2003: Circuit Design Generator Value Propositions
2002: FPGA Scaling Problems
2002: Marketing Focus
2002: Diversity and Scalability
2002: Deterministic Timing

2002: Execution Risks
2002: Problems Solved Uniquely by BTC Products
2002: ILOC Budget, Staffing, and Monthly Technical Milestones
2002: Chip Area Analysis
2002: Tool-chain Integration
2002: Seed Funding Milestones
2002: Use of Proceeds – Three Alternatives
2002: Losp Functionality
2001: Packaging Options
2001: Comparative Products
2001: Cost Effectiveness of BTC Hardware Architectures
2001: FPGA Comparative Analysis
2001: CPLD and FPGA Markets

Bricken Technologies Corporation — Products:

2004: Losp Synthesis System: Comparative Capabilities
2004: Losp Synthesis System: Technical Descriptions
2004: Losp Synthesis System: Overview
2004: ILOC Delay Reduction Comparative Performance
2004: ILOC Development Project — Deliverables, Timetables, Agenda, and Milestones
2004: ILOC Development Final Report
2003: ILOC Development Overview
2003: ILOC Comparative Area Reduction
2003: ILOC Project Design Descriptions
2003: ILOC Formatting
2003: Comesh Computational Mesh Patent Draft
2003: Iconic Logic Optimizing Compiler Patent Draft
2003: Place and Route Refinements
2003: Place and Route Statistics
2003: Place and Route Examples
2003: ILOC Logic Reduction and Comesh Layout for the SP700
2003: ILOC Logic Reduction and Comesh Layout for the SP700 — Technical Supplement
2003: Comesh Comparative Benchmarks
2003: Applications for Embedded Comesh
2002: State of the ILOC Code
2002: Occlusion Array Patent Draft
2002: Schematics for the Comesh Architecture
2002: Comesh Functional Model — Illustrated Tour
2002: Comesh Cost of Silicon
2002: Comesh Specifications
2002: Comesh Encoding
2002: ILOC Implementation Validation
2001: Interface Protocols
2001: Computational Mesh

Bricken Technologies Corporation — Technical:

2004: Top-down and Bottom-up Abstraction
2004: Spatial Symmetry in Logic
2004: The Advantages of Boundary Logic -- A Common Sense Approach
2004: Multiprocessing Tools
2003: Non-symbolic Proof
2003: ILOC Modular and Vector Abstraction
2003: I7 Abstraction
2003: Introduction to Boundary Logic with Sidebars
2002: Varieties of Adders
2002: From Sketch to Silicon
2002: Elusive Complexity
2002: Boundary Logic Applied to Circuitry
2002: Recursive Axiomatization of Boundary Logic
2002: CPU Architectures
2002: Conventional Interpretation of Boundary Logic Tools
2002: Occlusion Array Algebra
2002: Metalogic
2002: Nonsymbolic Logic
2002: Iconic Universe
2002: Pedagogical Coding
2002: On the Complexity of Boundary Logic
2001: Diagonalization of the Occlusion Array
2001: Using Occlusion to Evaluate Circuits
2001: CM85A: Occlusion Array
2001: CM85A: Algorithms
2001: CM85A: Metrics
2001: CM85A: Encoding
2001: CM85A: Schematics
2001: An Extended Example of Design Generation — CM85A, a 4-bit Magnitude Comparator
2001: Programming Heuristics in Losp
2001: Boundary Logic Languages
2001: Boundary Logic Simplified
2001: Boundary Logic Notes for Randy Katz
2001: Design of Microelectronic Integrated Circuitry
2001: The Logic Function
2001: Representations of Boundary Logic
2001: Computational Architectures
2001: Iconic Mathematics
2001: Boundary Logic Overview
2001: Boundary Numbers

Unary Computers:

2001: J, the Simplest Imaginary Number
2001: Boundary Mathematics from the Beginning
2001: Axiomatization of Boundary Logic

2001: People in Boundary Math
2001: Peirce on Boundary Logic
2001: Unary Business Sketch
2000: Dense Matrix Techniques
2000: Bar Architecture
2000: Using Occlusion to Evaluate Circuits
2000: Void-based Computation
2000: Exotic Boundary Number Systems
2000: Set Aside a Space

Interval Research Corporation:

2000: Integration of Losp into CAD Design
2000: Sequential Circuit Modeling and Simulation in Losp
1999: Boundary Logic Patent Draft
1999: Losp 6.5 Code Documentation
1998: A Calculus for Multilevel Combinational Circuit Minimization (book)
1998: Visualization of Circuit Minimization
1998: Losing Consciousness at Tuscon III
1998: A Question within a Question
1998: Generalized Insertion
1997: Losp 6.0 Code Documentation
1997: Bit-stream Circuit Simulation
1997: Hierarchical Modeling in Pun-Losp
1997: Symmetry in Boolean Functions
1997: Notes on Matrix Techniques for Logic
1997: Models of Circuit Properties in Losp
1997: Finite State Machines in Losp
1997: Form Abstraction in Distinction Graphs
1996: Modeling for Hardware and Software Integration
1996: Time as Depth
1996: Forms of Addition
1996: Notational Discussions
1996: Multiply Accumulators
1996: Algebra, Logic, Integers, Functions, and Sets
1996: Circuit Generators
1995: Synthesis Capabilities of Losp
1995: Losp 4.0 Usage
1995: Losp Applied to MCNC Benchmarks
1995: Possibility Waves
1995: Strategies for Combinatorial Circuit Optimization
1995: Probabilistic Timing of Combinatorial Circuits
1995: Logic Synthesis
1995: Cyclic String Notation
1995: Boolean Function Manipulation
1994: Documentation, Losp 2.0, 3.0, and 4.0
1994: Boundary Mathematics as an Integration Strategy for Computing
1994: Where Quantum Logic Differs from Classical Logic

1993: FPGAs and Boundary Logic
1993: Circuits and Boundary Logic

Oz...International, Ltd.:

1994: Design of a Location-based VR Entertainment Unit
1994: Interactive Software Tools for Experiential Computing
1993: Smart Spatial Engine and Algorithms for Physical Dynamics (with J. Duluk)
1993: Declarative Logic Accelerator (with W. Kohn)
1993: Spatial Database Accelerator (with J. Duluk)
1992: Oz Business Plan: EduSpace (with M. Bricken)

Human Interface Technology Laboratory:

1994: Embedding Mathematics in a Virtual World
1993: A Second Step Towards Virtual Reality: The Entity Model and System Design
1993: Experiential Computation
1992: VEOS Project Programmer's and Tool Builder's Manuals (with G. Coco)
1992: VEOS Design Goals
1991: Learning in Virtual Reality
1991: Meta Operating System and Entity Shell (with D. Pezely)
1990: Dialogue Concepts
1990: Virtual Interface Technology, Siggraph Tutorial
1990: Boundary Logic, Boundary implementations
1990: VR Directions of Growth
1990: Virtual reality is Inhabited
1990: Cognitive Models
1990: VEOS Preliminary Functional Architecture
1990: Software Architecture for Virtual Reality

Autodesk Research Laboratory:

1989: The Cyberspace Project (with M. Bricken, E. Gullichsen, R. Walser, P. Gelband)
1989: Cyberspace Toolkit Software Design
1989: Geometrical and Biological Models for Space Building
1989: Fracturtles: Pictures that Compute
1988: State of the Lab
1988: Computational Drawings
1988: Mathematica Exposed
1988: Boundary Logic
1988: Boundary Thinking
1988: Autolab: Images and Ideas

Advanced Decision Systems:

1988: AI Based Tools and Concepts for Cockpit Automation Technology (with S. Crawford)
1987: Distinction Networks and Neural Networks
1987: Distinction Network Parallel Processing
1987: Distinction Network Logic

1987: The Problem of Robustness: A Multi-valued Logic Approach (with P. Haddawy)
1987: Toward Real-time Inference
1987: The Efficiency of Boundary Mathematics for Deduction
1987: A Boundary Logic Tutorial with the Losp Parallel Deduction Engine (with E. Gullichsen)
1987: Boundary Numbers
1987: Utilizing Boundary Mathematics for Deduction
1987: An Intelligent Program Editor (with S. Rosenbaum)
1986: Visual Programming
1986: Machine Learning using Self-Organizing Distinction Networks
1986: A Deductive Mathematics for Efficient Reasoning
1986: Implementation of the Semantic Component of the Extended Program Model
1986: Implementation of the Extended Program Model
1986: Analysis of Errors in Mathematics
1986: Software Architecture for CASES
1986: Boolean Formal Systems
1985: An Instructable Interface
1985: Distributed Performance Maintenance for Ballistic Missile Defense
1984: A Program Reference Language
1984: Development of an Intelligent Maintenance Training Technology
1984: Intelligent Maintenance Training Systems

Stanford University:

1986: The Canons of Formal Symbol Systems
1984: Laws of Form: Primary Arithmetic and Primary Algebra (qualifying exam)
1984: Curriculum Recapitulates Discovery
1984: The Procedural Curriculum
1984: A Parenthesis around Logical Foundations
1983: Logical and Cognitive Interpretations of the Laws of Form Applied to Artificial Intelligence

Atari Sunnyvale Research Laboratory:

1983: Logical Proof using Losp
1983: A Model Interface Model
1983: Fractal Dimensions