

## Vita for ALBERT G. BOULANGER

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### EDUCATION

B.S. (Physics), University of Florida, 1978  
M.S. (Computer Science), University of Illinois, 1982

### EXPERIENCE

2006-Present Center for Computational Learning Systems, Columbia University  
Senior Staff Associate

2010-Present World Team Building, LLC Partner

2005-Present World Team Now, VP & Director of Technical Strategy

1994-2006 Lamont-Doherty Earth Observatory, Columbia University  
Senior Staff Associate, 4-D Group

2000-2002 CTO, vPatch Technologies, Inc

1992-1994 BBN Laboratories Division, BBN Systems and Technologies  
Corporation, Cambridge, Massachusetts  
Scientist Applied Physics Department.

1982-1992 BBN Laboratories Division, BBN Systems and Technologies  
Corporation, Cambridge, Massachusetts  
Scientist, Intelligent Systems Department

University of Illinois, Urbana, Illinois  
1980-1982 Research Assistant, Department of Computer Science.  
1979-1980 Teaching Assistant, Department of Computer Science.  
1973-1979 National Hurricane and Experimental Meteorology  
Part time Laboratory, Coral Gables, Florida  
Programmer

1979 Altair Computer Center of Miami, Miami, Florida  
Part time Repair Technician.

1978 B.P.I. Incorporated, Miami, Florida  
Part time Programmer

1974-1977 University of Florida, Gainesville, Florida  
Part time Physics Technician, Department of Electrical  
Engineering

## HONORS

Three Special Achievement Awards from the National Hurricane and Experimental Meteorology Laboratory for accomplishments in programming and work on lightning.

Co-winner of the Max A. Eaton prize for best student paper at the 11th Technical Conference on Hurricanes and Tropical Meteorology.

## EXPERTISE

Systems integration, expert and knowledge-based systems, machine learning and pattern recognition including the interface between numerical and symbolic algorithms, parallel computing, pattern recognition applied to 4D seismic data, computer representations of complex scientific and engineering objects, visualization, distributed systems and interoperability.

## PROFESSIONAL RESPONSIBILITIES AND PROJECTS

Albert Boulanger is Senior Staff Associate with the Center for Computational Learning Systems (CCLS) of Columbia University. At Columbia University, Albert has been involved in far reaching energy research and development involving intelligent systems in electrical power, renewable energy, smart buildings, smart grids and smart cities for over 20 years. His specialties are complex systems integration and intelligent computational reasoning that interacts with humans within large scale systems.

He leads the Smart-X group at CCLS. Recent projects include a reinforcement learning based microgrid controller for Africa villages, and optimal placement of inductive charging stations for electric buses. For Con Edison, current projects include image processing of thermal images to look for trouble in manholes and using causal inference and machine learning to produce a Cost vs. Benefit study of reliability improvement programs. As part of a partnership with the Rudin Management Company and Finmeccanica, the Smart-X group developed the machine learning based forecasting and recommendation capability for the Di-BOSS Smart Building Solution

Albert Boulanger is a board member, VP & Director of Technical Strategy of the nonprofit environmental and social organization, World Team Now and is a partner in the related company, World Team-Building, LLC. For both, he advises on big picture technical matters and technical implementation decisions. He leads the Platform Launching Alternative & New Technology & Energy (PLANET) unit within World Team Now which seeks and catalyzes the incubation of technology core to World Team Now's mission. He is also a co-founder of CALM Energy, Inc.

Albert Boulanger was Senior Staff Associate in the 4-D Group at the Lamont-Doherty Earth Observatory of Columbia University. Albert Boulanger worked on new business development within Roger Anderson's group at Lamont. At Lamont, Albert Boulanger worked on introducing machine learning concepts in asset management of power grids and oil and gas which led several Con Edison projects at CCLS.

He worked on computer science aspects of industry consortia, including visualization, system integration, advanced computation, databases, and interoperability. Albert Boulanger visualized portfolio management data and results for the industry-sponsored portfolio management consortium. Albert Boulanger also worked on pattern recognition methods for identifying and tracking changes in oil and gas reservoirs by making use of multiple seismic surveys shot over time.

Albert Boulanger was CTO for vPatch Technologies, Inc on leave of absence from Columbia for two years. vPatch's business focus was to implement wired processes that connect business decision-making and hydrocarbon reservoirs in real time to enable the use of portfolio management, real-options, EVA and other modern techniques to plan and execute enterprise optimization.

At BBN Laboratories, he worked on developing software for STEAMER, an advanced computer aided system for propulsion engineering training. This project featured sophisticated interactive graphics capabilities, explanations and illustrations of basic propulsion principles, and tutorials.

Albert Boulanger was involved in the specification, building, and delivery of DesigNet, an intelligent CAD tool for designing packet switching networks. He also prototyped a system for automated network management.

Albert Boulanger was a principle designer and implementer of FLEX; a generic rule based system, and assisted in integrating FLEX with Kreme. Kreme was BBN's knowledge acquisition system built for DARPA's Strategic Computing Program. He also integrated the Flex Rule editing interface to a human factors simulation of radar operators. Under NASA funding, he evaluated an existing rule system that predicts wind shear severity. Albert Boulanger also advised in the design of a structure-editing query interface to a time-series oriented expert failure analysis system.

Another responsibility was teaching AI techniques that included building a rule-based shell for an expert classifier of tax returns to clients. Following this, Albert Boulanger was involved in the development of a custom knowledge engineering environment for an expert classification prototype being developed for the IRS. He built a multiple-knowledge base management system for the IRS knowledge engineering environment that included a hierarchical organization of knowledge bases with entity inheritance and also included the support for versions across hierarchies of knowledge bases.

Albert Boulanger was involved with the development of Lisp and other artificial intelligence tools for the BBN Butterfly multi-processor. This included managing the development of a parallel manufacturing-process simulation/diagnostic demonstration that ran on a Butterfly and Symbolics computer coupled together.

Under IR&D funding, Albert Boulanger was involved in a project that investigated the use of neural networks, statistical tree classifiers, statistical clustering, and other machine learning algorithms for the purpose of extracting and exploring "latent" knowledge from existing databases.

Albert Boulanger investigated methods using unsupervised clustering to automate the analysis of recorded conversations of ground-control to plane conversations. This work required the integration of several diverse technologies: AI, GUI, natural language processing, speech recognition, and statistical pattern recognition. He was responsible for the implementation and design of the initial prototype of this system, called Gister.

Albert Boulanger managed the Applied and Computational Mathematics seminar series. He was involved in developing materials for a course in dynamical systems for high school students under NSF funding. He maintained a community of ten lisp machines.

Albert Boulanger prepared another system called PRISM, implemented in Lisp, ready for beta test. The goal of PRISM was to support engineering acoustics design.

Albert Boulanger was also responsible for the design and integration of image management and manipulation functions for an Army project called MIDAS. MIDAS integrated data base technology with image analysis and acoustic modeling functions.

At the University of Illinois, Albert Boulanger helped in the development of ADVISE, a large, general-purpose expert system which included rule interpreters and knowledge representation tools. While at the university, he implemented expert systems for use in agriculture and financial analysis. He also designed and built a data acquisition system for a CCD camera.

At the National Hurricane and Experimental Meteorology Laboratory, Albert Boulanger was responsible for developing data analysis programs and using them on collected lightning data. He also designed the hardware for a data acquisition system used in the lightning study.

## **BOOKS**

Computer-Aided Lean Management for the Energy Industry, Roger N. Anderson, Albert Boulanger, John A. Johnson, Arthur Kressner, PennWell Books, 2008

## **PUBLICATIONS**

"An Innovative Approach to Vehicle Electrification for Smart Cities." Promiti Dutta, Albert Boulanger, Roger Anderson and Leon Wu. Handbook of Research on Social, Economic, and Environmental Sustainability in the Development of Smart Cities. IGI Global, 2015. 193-212.

"Di-BOSS: Research, Development & Deployment of the World's First Digital Building Operating System," Roger Anderson, Albert Boulanger, Vaibhav Bhandari, Jessica Forde, Ashish Gagneja, Arthur Kressner, Ashwath Rajan, Vivek Rathod, Doug Riecken, David Solomon, Leon Wu, John Gilbert, Eugene Boniberger, Mattia Cavanna, Willem Neiuwkerk, Bruce Sher, Nate Maloney in Automated Diagnostics and Analytics for Buildings, Fairmont Press, 9/2014

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"Cost-optimal, robust charging of electrically-fueled commercial vehicle fleets via machine learning," Systems Conference (SysCon), Jigar Shah, Matthew Nielsen, Andrew Reid, Conner Shane, Kirk Mathews, David Doerge, Richard Piel, Roger Anderson, Albert Boulanger, Leon Wu, Vaibhav Bhandari, Ashish Gagneja, Arthur Kressner, Xiaohu Li, and Somnath Sarkar, 2014 8th Annual IEEE , vol., no., pp.65,71, March 31 2014-April 3 2014

"A Robust Solution to the Load Curtailment Problem," Hugo P. Simão, Hyun Bin Jeong, Boris Defourny, Warren B. Powell, Albert Boulanger, Ashish Gagneja, Leon Wu, Roger N. Anderson, IEEE Transactions on Smart Grid, vol.4, no.4, pp.2209,2219, Dec. 2013

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David Solomon, Lauren Hannah, Albert Boulanger, Roger Anderson,” 2013 Conference on Neural Information Processing Systems (NIPS 2013), Demonstration 12/6/2013

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“Machine Learning for the New York City Power Grid,” Cynthia Rudin, David Waltz, Roger Anderson, Albert Boulanger, Ansaf Salieb-Aouissi, Maggie Chow, Haimonti Dutta, Philip Gross, Bert Huang, and Steve Jerome, Transactions on Pattern Analysis and Machine Intelligence Volume 34 Issue 2, February 2012

“Failure Analysis of the New York City Power Grid,” Leon Wu, Roger N Anderson, Albert G Boulanger, Cynthia Rudin, Gail E Kaiser, CU CS Technical Report CUCS-025-14, 2012

“Using Support Vector Machine to Forecast Energy Usage of a Manhattan Skyscraper,” Rebecca Winter, Albert Boulanger, Roger Anderson, Leon Wu, AGU Fall Meeting Abstracts 1, 0984, 2011

“Vehicle Electrification: Status and Issues,” Albert Boulanger, Andy Chu, Suzanne Maxx, and David Waltz, Proceedings of the IEEE , vol.99, no.6, pp.1116-1138, June 2011

“Adaptive Stochastic Control for the Smart Grid,” Roger Anderson, Albert Boulanger, Warren Powell, and Warren Scott, Proceedings of the IEEE , vol.99, no.6, pp.1098-1115, June 2011

“Estimation of System Reliability Using a Semiparametric Model,” Leon Wu, Timothy Teravainen, Gail Kaiser, Roger Anderson, Albert Boulanger, and Cynthia Rudin, Proceedings of IEEE EnergyTech, 2011.

“Evaluating Machine Learning for Improving Power Grid Reliability,” Leon Wu, Gail Kaiser, Cynthia Rudin, David Waltz, Roger Anderson, Albert Boulanger, Ansaf Salieb-Aouissi, Haimonti Dutta, and Manoj Poolery, Proceedings of the ICML 2011 workshop on Machine Learning for Global Challenges, International Conference on Machine Learning, 2011.

“Estimating the Time Between Failures of Electrical Feeders in the New York Power Grid,” Haimonti Dutta, David Waltz, Alessandro Moschitti, Daniele Pighin, Philip Gross, Claire Monteleoni, Ansaf Salieb-Aouissi, Albert Boulanger, Manoj Poolery and Roger Anderson, Next Generation Data Mining Summit, NGDM 2009, Columbia MD.

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“LEAN ENERGY MANAGEMENT-12: Gas-to-electricity real options can provide deepwater strategic, operational flexibility,” Roger Anderson, Albert Boulanger & John Johnson, Oil&Gas Journal July 23, 2007

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Charles Lawson , Roger Anderson, Matthew Koenig, Mark Mastrocinque, William Fairechio, John A. Johnson, Serena Lee, Frank Doherty, Arthur Kressner, Eighteenth Innovative Applications of Artificial Intelligence Conference Boston, Massachusetts July 18-20 2006

“LEAN ENERGY MANAGEMENT-11: Martingale Control of 4-D Seismic Reservoir Management,” Roger Anderson and Albert Boulanger, Wei He, Ulisses Mello and Liqing Xu, Oil&Gas Journal May 15 2006

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“LEAN ENERGY MANAGEMENT-8: Use of matrices in computer-aided lean energy management,” Anderson, R., A. Boulanger, Oil&Gas Journal March 7, 2005

“LEAN ENERGY MANAGEMENT-7: Knowledge management and computational learning for lean energy management,” Anderson, R., A. Boulanger, Oil&Gas Journal November 22, 2004

“LEAN ENERGY MANAGEMENT-6: Ultradeep offshore suitability matrix for estimating value of Lean Processes,” Anderson, R., A. Boulanger, Oil&Gas Journal June 28, 2004

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“LEAN ENERGY MANAGEMENT-2: Ultradeepwater oil-gas development: Designing uncertainty into the enterprise,” Anderson, R., A. Boulanger, Oil&Gas Journal May 19, 2003

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"4-D Seismic: The Fourth Dimension in Reservoir Management. Part 4: Inversion Of 4-d Seismic Changes To Find Bypassed Pay," He, W. ; Anderson, R.n. ; Boulanger, A. ; Teng, Y.c. ; Xu, L.; Neal, R. ; Meadow, B., World Oil ; VOL. 218 ; ISSUE: 7 ; PBD: Jul 1997

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"4-D Seismic: The Fourth Dimension in Reservoir Management Part 1: What is 4-D and how does it improve recovery efficiency?," Roger Anderson, Albert Boulanger, Wei He, Yu-Chiung Teng, Billy Meadow, and Randall Neal, World Oil, March 1977

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"How 4D Seismic Monitoring Works," Liqing Xu, Roger N. Anderson, Albert Boulanger, and Wei He, AAPG Explorer, October 1996

"Seismic Advances Moving In from 'Far-Field' Industries," Albert Boulanger, Roger Anderson, and Jim Barger, American Oil & Gas Reporter, July 1996

"Visualization of Hydrocarbon Drainage Using 4-D Seismic Techniques," R.N. Anderson, A. Boulanger, W. He, Session - AAPG 5/21 1996: 3-D/4-D Modeling and Visualization in Exploration and Development - Best of Archie Conference, 1995

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"4D Seismic Helps Track Drainage, Pressure Compartmentalization, Gulf of Mexico Management -- 1," Roger N. Anderson, Albert Boulanger, Wei He, Y.F. Sun, David Sibley, John Austin, Richard Woodhams, Liqing Xu, Richard Andre, and Kent Reinhart), *Oil & Gas Journal*, 93, no. 13, March 27, 1995

"Method Described for Using 4D Seismic to Track Reservoir Fluid Movement, Gulf of Mexico Management -- 2," Roger N. Anderson, Albert Boulanger, Wei He, Y.F. Sun, David Sibley, John Austin, Richard Woodhams, Liqing Xu, Richard Andre, and Kent Reinhart), *Oil & Gas Journal*, 93, no. 14, April 3, 1995

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"Gisting Conversational Speech", R. Rohlicek, D. Ayuso, M. Bates, A. Boulanger, P. Jeanrenaud, M. Meteer and M. Siu, *Proc. International Conference on Acoustics, Speech and Signal Processing*, volume 2, pages 113-116, 1992.

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"On the frequency of cloud-to-ground lightning from tropical cumulonimbus clouds.," Albert G. Boulanger, & Michael W. Maier, Proceedings, 11th Technical Conference on Hurricanes and Tropical Meteorology, December 13-16, Miami Beach, Florida, American Meteorological Society, Boston, 1977, pp. 450-454.

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## **PATENTS**

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## **ORAL PRESENTATIONS**

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"Modeling Asynchronous Iterative Methods with Delay Equations," Presentation at the IMACS workshop on Delay Equations, April 1990.

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"Educating for New Paradigms in Artificial Intelligence," Talk at the American Society of Engineering Educators meeting, September 1986.

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