Dr. Piero P. Bonissone

Chief Scientist, Coolidge Fellow

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Brief Summary

A Chief Scientist at GE Global Research, Dr. Bonissone has been a pioneer in the field of fuzzy logic, AI, soft computing, and approximate reasoning systems applications since 1979. During the eighties, he conceived and developed the Diesel Electric Locomotive Troubleshooting Aid (DELTA), one of the first fielded expert systems that helped maintenance technicians in troubleshooting diesel-electric locomotives. He has been the PI in many DARPA programs, from Strategic Computing Initiative, to Pilot's Associate, Submarine Operational Automation System, and Planning Initiative (ARPI). During the nineties, he led many projects in fuzzy control, from the hierarchical fuzzy control of turbo-shaft engines to the use of fuzzy logic in dishwashers, locomotives, and resonant converters for power supplies. He designed and integrated case-based and fuzzy-neural systems to accurately estimate the value of single-family residential properties when used as mortgage collaterals. In early 2000, he designed a fuzzy-rule based classifier, trained by evolutionary algorithms, to automate the placement of insurance applications for long term care and term life, while minimizing the variance of their decisions. This classifier has been in production since 2003. Recently he has led a Soft Computing (SC) group in the development of SC application to diagnostics and prognostics of processes and products, including the prediction of remaining life for each locomotive in a fleet, to perform efficient assets selection. His current interests are the development of multi-criteria decision making systems for PHM and the automation of intelligent systems lifecycle to create, deploy, and maintain SC-based systems, providing customized performance while adapting to avoid obsolescence.

He is a **Fellow** of the Institute of Electrical and Electronics Engineers (IEEE), of the Association for the Advancement of Artificial Intelligence (AAAI), of the International Fuzzy Systems Association (IFSA), and a **Coolidge Fellow** at GE Global Research. Since 2010, he is the President of the Scientific Committee of the European Centre of Soft Computing. In 2008 he received the *II Cajastur International Prize for Soft Computing* from the European Centre of Soft Computing. In 2005 he received the *Meritorious Service Award* from the IEEE Computational Intelligence Society. He has received two *Dushman Awards* from GE Global Research. He served as **Editor in Chief** of the *International Journal of Approximate Reasoning* **for 13 years**. He is in the editorial board of five technical journals and is Editor-at-Large of the *IEEE Computational Intelligence Magazine*. He has **co-edited six books** and has **over 150 publications** in refereed journals, book chapters, and conference proceedings, with an **H-Index of 27** (using Google Scholar). He received **61 patents issued** from the US Patent Office (plus 50 pending patents). From 1982 until 2005 he has been an Adjunct Professor at Rensselaer Polytechnic Institute, in Troy NY, where he has **supervised 5 PhD theses** and **33 Master theses**. He has **co-chaired 12 scientific conferences** and symposia focused on Multi-Criteria Decision-Making, Fuzzy sets, Diagnostics, Prognostics, and Uncertainty Management in AI. Dr. Bonissone is very active in the IEEE, where is has been a member of the Fellow Evaluation Committee from 2007 to 2009. In 2002, while serving as **President of the IEEE Neural Networks Society** (now Computational Intelligence Society) he was also a member of the IEEE Technical Board Activities (TAB). He has been an Executive Committee member of NNC/NNS/CIS society since 1993 and an IEEE CIS Distinguished Lecturer since 2004.

Academic Background

- PhD (1979), Electrical Engineering and Computer Science, University of California, Berkeley, CA
- MS (1979), Mechanical Engineering, University of California, Berkeley, CA
- MS (1976), Electrical Engineering and Computer Science, University of California, Berkeley, CA
- BS (1975), Electrical and Mechanical Engineering, University of Mexico City (UNAM), Mexico

Research Interests

- Soft Computing
- Fuzzy Logic
- Multi-Criteria Decision Making
- Multi-Objective Optimization
- Evolutionary Alg.
- Progn. & Health Mgmt
- Multiple Classifier Systems
- Int. Syst. Life-Cycle
- Machine Learning
- Data Mining
- Case Based Reasoning
- Pattern recognition

Experience

GE Global Research – Niskayuna, NY
Chief Scientist / Computer Scientist (Sept 2007 - present; / Nov 1979 - Sept 2007)

Rensselaer Polytechnic Institute, Troy, NY
Adjunct Professor (1982 - 2005)

UC Berkeley, Electronics Research Lab – Berkeley, CA
Research Assistant (1976 - 1979)

University of Mexico City (UNAM) - Electrical Mechanical Engineering Dept.
Teaching Assistant (1972 - 1975)

Honors and Awards: External Recognition

- 2012: Fuzzy Systems Pioneer Award, IEEE Computational Intelligence Society - approved June 5, 2011
- 2008: II Cajastur International Prize for Soft Computing, from the from Asturias' Savings Bank CajAstur (Spain) and the Foundation for the Advancement of Soft Computing, (pdf - page 3)
- 2005: Meritorious Service Award from the IEEE Computational Intelligence Society
- 2005: ***Fellow*** of the International Fuzzy Systems Association (IFSA) International Fuzzy Systems Association (IFSA) for his *"achievements in the research of Fuzzy Systems and service to IFSA"*
- 2004: ***Fellow*** of the Institute of Electrical and Electronics Engineering (IEEE) for his "*leadership in the development of artificial and computational intelligence techniques and their applications to real-world problems"*
- 1996: ***Fellow*** of the Association for the Advancement of Artificial Intelligence (AAAI) for *"his pioneering development of uncertainty calculus and its application to fuzzy-logic based control systems"*
- 1986: *King-Sun Fu Award* from the North American Fuzzy Information Processing Society (NAFIPS) for his "*distinguished services to NAFIPS"*
- 1977: *Early C. Anthony Scholarship*, from the EECS Department, University of California, Berkeley, CA
- 1976: *Education Abroad Program Scholarship*, from the EECS Department, University of California, Berkeley, CA
- 1975: *Mención Honorifica (Summa cum Laude)* from University of Mexico City (UNAM), Mexico

Honors and Awards: Internal Recognition (from GE Global Research)

- 2006: *Asian Pacific American Forum (APAF) Outstanding Mentor Award*
- 2006: *EB recognition dinner* at Fairfield with Jeff Immelt
- 2005: *6+2 Award* for his role in the *"Fixed Income Insurance Platform"* development for GE Financial Assurance/Genworth
- 1999: *Dushman Award* for his *"role in developing diagnostics software tools for GE medical equipment"*
- 1999: *ITL Mentor of the Year Award*
- 1993: ***Coolidge Fellowship*** *Award* for "*overall technical accomplishments*". In 1995 he leveraged this fellowship to shape and develop a new research agenda on Soft Computing (SC) while he was a visiting scientist for ten months at the AI Research Institute (Instituto de Investigacion en Inteligencia Artificial, IIIA-CSIC), in Bellaterra, Barcelona, Spain
- 1989: Dushman Award for his "*role in the Reasoning with Uncertainty Module (RUM)*"

Honors and Awards: Patents and Publications

- 2011: *50th Patent Issued* - GE Global Research (pending)
- 2009: *150 Publications Award* - GE Global Research
- 2006: *125 Publications Award* - GE Global Research
- 2004: *100 Publications Award* - GE Global Research
- 2003: *Best Paper Award* (with R. Subbu) - IEEE 2003 Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'03)
- 2003: *25th Patent Issued* - GE Global Research
- 2003: *Gold Medallion Patent Award,* (for 20 patents received) - GE Global Research
- 1994: *Silver Medallion Patent Award* (for 10 patent applications) - GE Global Research
- 1988: *Bronze Medallion Patent Award* (for first-time inventor) - GE Global Research

Professional Societies (Memberships and Activities)

- IEEE (Fellow), AAAI (Fellow), IFSA (Fellow) ACM (Sr. Member), and NAFIPS (Member)

NAFIPS, ACM, AAAI, UAI Activities:

- 2008; Organizer of special session on Multi-Criteria Decision-Making at IPMU 2008
- 2002: Co-Chair of the Information Refinement and Revision for Decision Making: Modeling for Diagnostics, Prognostics, and Prediction Symposium in the AAAI'02 Spring Symposium Series
- 1999: Co-Chair of the AI Equipment Maintenance Service and Support Symposium in the AAAI'99 Spring Symposium Series
- 1997: Senior Program Committee Member of AAAI'97
- 1995: Member of IJCAI'95 Advisory Board
- 1994-95: ACM Lecturer
- 1991: General Chair, 1991 Conference on Uncertainty in Artificial Intelligence (UAI91)
- 1990: Program Chair, 1990 Conference on Uncertainty in Artificial Intelligence (UAI90)
- 1985: Member Founding Board of Directors of NAFIPS
- 1982: Program Chair of NAFIPS II

IEEE Activities (Committees & Boards)

- 2010-11: *Member*, IEEE Frank Rosenblatt Award
- 2007-2009: *Member*, IEEE Fellow Committee
- 2007 *Member*, IEEE Division X Nomination Committee
- 2007: *Past Chair*, IEEE Frank Rosenblatt Award
- 2006 *Alternate Member*, IEEE Fellow Committee
- 2005-2006: *Chair*, IEEE Frank Rosenblatt Award
- 2005 *Member*, IEEE Division X Nomination Committee
- 2002:*Member*, IEEE Technical Activities Board (TAB)

IEEE Activities (Societies)

- 20011: *Vice-Chair (Americas),* IEEE CIS Technical Committee on Fuzzy Systems
- 2010-11: *Chair*, IEEE CIS Fellow Committee
- 2010-11: *Member* IEEE CIS Strategic Planning Committee
- 2010: *Member* IEEE CIS Distinguished Lecturers Program Sub-committee
- 2010: *Member* IEEE CIS Industry Liaison Sub-committee
- 2010: *Member* IEEE CIS Award for Outstanding CI Organization Sub-committee
- 2010: *Member* IEEE CIS Continuing Education Sub-committee
- 2008-11: *Vice-Chair (Americas),* IEEE CIS Technical Committee on Emergent Technologies
- 2008-11: *Member,* IEEE CIS Constitution and Bylaws Committee
- 2007: *Member,* IEEE CIS Technical Committee on Emergent Technologies
- 2005-2012: *Vice-President* Finance, IEEE Computational Intelligence Society (IEEE-CIS)
- 2005-2009: *Member*, IEEE CIS Awards Committee
- 2005-2007: *Chair,* IEEE CIS Constitution and Bylaws Committee
- 2004-2005: *Chair,* IEEE CIS Fellow Committee
- 2004-11: *Member,* IEEE CIS Distinguished Lecturer Program
- 2004: *Vice-President* Elect Finance, IEEE CIS
- 2003-10: *Member,* IEEE CIS Technical Committee on Fuzzy Systems
- 2003-2004: *Chair,* IEEE CIS Constitution and Bylaws Committee
- 2003 *Chair*, IEEE CIS Society Nomination Committee
- 2003: *Past President*, IEEE Computational Intelligence Society (previously NNS)
- 2002: ***President***, IEEE Neural Network Society (IEEE-NNS)
- 2001: *President Elect*, IEEE Neural Networks Council (IEEE-NNC)
- 1994-2010: *Member,* IEEE NNC/NNS/CIS Conference Committee
- 1993-2000: *Vice-President Finances*, IEEE Neural Network Council (IEEE-NNC)

IEEE Activities (Conferences)

- 2011 *Advisory Committee Member*, IEEE Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'11)
- 2011 *Symposium Co-Chair*, IEEE Symposium on Computational Intelligence and Industry (CII 2011)
- 2011 *Symposium Co-Chair*, Third IEEE Symposium on Computational Intelligence in Multi-Criteria Decision-Making (MCDM 2011)
- 2011 *Treasurer*, IEEE Symposium Series on Computational Intelligence (SSCI 2011)

- 2010 *Treasurer*, IEEE World Conference on Computational Intelligence (WCCI 2010)
- 2010 *Conference Chair*, IEEE Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'10)
- 2009 *Treasurer*, IEEE Symposium Series on Computational Intelligence (SSCI 2009)
- 2009 *Program Co-Chair*, Second IEEE Symposium on Computational Intelligence in Multi-Criteria Decision-Making (MCDM 2009)
- 2007 *Program Co-Chair*, First IEEE Symposium on Computational Intelligence in Multi-Criteria Decision-Making (MCDM 2007)
- 2006 *Program Co-chair*, IEEE 2006 Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'06)
- 2002: *Co-treasurer*, IEEE 2002 World Congress on Computational Intelligence (WCCI'02)
- 2002: *Technical Co-Chair*, 2002 IEEE Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'02)
- 1997: *Co-treasurer*, 1997 IEEE Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'97)
- 1994: *Conference Chair*, 1994 IEEE Int'l Conf. on Fuzzy Systems, WCCI 94 (FUZZ-IEEE'94)
- 1993: *Program Chair*, 1993 IEEE Int'l Conf. on Fuzzy Systems (FUZZ-IEEE'93)

IEEE Activities (Section & Chapters)

- 2005-Present: *Member*, IEEE CIS Schenectady Chapter

Editorial Activities

- 2006-Present: *Editor-at-Large*, IEEE Computational Intelligence Magazine
- 1993-2005: *Editor-in-Chief*, International Journal of Approximate Reasoning – Edited 99 issues with 33 volumes (8 – 40)
- *Member Editorial Board:*
  - Int'l Journal of Approximate Reasoning
  - Fuzzy Sets and Systems
  - Int'l Journal of Uncertainty, Fuzziness, and Knowledge-Based Systems
  - Journal of Multiple-Valued Logic and Soft Computing (term ended in 2010)
- Soft Computing: A Fusion of Foundations, Methodologies and Applications *Member Steering Committee:*
  - IEEE Transactions of Computational Intelligence and AI in Games
  - IEEE Symposium on Computational Intelligence in Multi-Criteria Decision Making (MCDM)

Educational Activities

- 2011: Lecturer in *System Identification: Regression, Prediction and Time Series* for the Master Degree Program in Soft Computing and Intelligent Data Analysis, organized by the **European Centre of Soft Computing** and the University of Oviedo, Spain, May 16-17, 2011
- 2010: Taught lecture on "*Computational Intelligence in Prognostics and Health Management (PHM)"*, Center for Advanced Life Cycle Engineering (CALCE), College Park, MD, Nov 8, 2010
- 2010: Lecturer in *System Identification: Regression, Prediction and Time Series* for the Master Degree Program in Soft Computing and Intelligent Data Analysis, organized by the **European Centre of Soft Computing** and the University of Oviedo, Spain, March 3-4, 2010
- 2007: Taught lecture on "*Computational Intelligence in Prognostics and Health Management (PHM) Management"*, Center for Advanced Life Cycle Engineering (CALCE), College Park, MD, October 30, 2007
- 2007: Taught two lectures at *"Future Directions in Soft Computing"* - First Summer Course, European Centre for Soft Computing, (ECSC), Oviedo, Spain, July 12-13, 2007
- 2006: Taught two lectures at Third Latin-American Summer School on Computational Intelligence, *EVIC 2006*, Santiago de Chile, Chile, December 13-15, 2006
- 1982- 2005: *Adjunct Professor,* Rensselaer Polytechnic Institute (ECSE & DSES), Troy, NY - Taught Fall Course on *Fuzzy Logics and Computational Intelligence*
- 2005: Created six lectures in *Soft Computing Applications for Prediction, Classification, and Model Lifecycle* for the International Master Degree's Program on Soft Computing for Industrial Applications (IMSCIA), an internet-based graduate program organized by the CS Dept, University of Milan (Universitá degli Studi di Milano), Italy
- 2002: *Professor,* REASON PARK (REASONing under PARtial Knowledge) Summer School, Foligno, Italy - Taught 1-week Summer Course on *Fuzzy Logic*
- 1990: *Professor*, CS Dept, University of Turin, Turin, Italy - Taught 2-week Summer Course on *AI*
- 1988: *Opponent* in Dimiter Driankov's PhD thesis, CS Dept., U. of Linkoeping. Sweden

- 1986-*Present: PhD Thesis Advisor* RPI ECSE Dept, CS Dept, DSES Dept: [5 theses]
- 1983-Present: *M.S/M.E Thesis Advisor* RPI (ECSE, CS, DSES); MIT (CS), UPC(CS) [33 theses]

Other Professional Activities

- 2010-2012: *President* of the Scientific Committee of the **European Centre of Soft Computing**
- 2009-2010: *Member* of the Scientific Committee of the **European Centre of Soft Computing**
- 2009-2011: *Member* of the Advisory Committee of the Italian Society of Neural Networks (SIREN)
- 2006: *Member* of DARPA Information Systems Advanced Technology (ISAT) Study on *Trustable, Deployed Adaptive Systems* – Contributor to study development and final report to DARPA
- 2005: *Member* of SOLE (International Society of Logistic) Study to shape DOD Joint Logistic Focus
- 2004-2005: *Presenter*, LOGTECH, Institute for Defense and Business, Kenan-Flagler Business School, UNC, Chapel Hill, NC - Taught numerous 1-day Courses on *AI applied to Logistics* to US flag officers and logistics agencies executives
- 2004-2005: *Panel Member* of DARPA-funded Collective Mind Study
- 2000 *External Reviewer* for the Adaptive and Intelligent Systems Application (AISA), for the Finnish Funding Agency for Technology and Innovation (TEKES)
- 1992-1994: *Visionary.* Responsible for *creating and evolving the ARPI-wide vision* in ARPA-Rome Lab Planning Initiative (ARPI)
- 1986-1987: *Member* of the Technical Advisory Board in DARPA Pilot's Associate Program

Leadership Positions

Professional Society Activities (IEEE)

As ***Chair of the IEEE Computational Intelligence Society Fellow Committee*** (in 2004-2005), as ***Member of the IEEE Fellow Committee*** (in 2007-2009), and more recently as ***Chair of the IEEE Computational Intelligence Society Fellow Committee*** (in 2010-11), I evaluated and ranked the nominations of hundreds of outstanding IEEE Senior members, as part of the selection process of the few who will be elevated to the grade of *Fellow*.

As the first ***Chair of the IEEE Frank Rosenblatt Award*** in 2005 and 2006, I created a committee and a process to foster the nomination of numerous potential candidates for the IEEE Frank Rosenblatt Award and to evaluate their candidacies.

As the first ***President of the IEEE Neural Networks Society*** (currently IEEE Computational Intelligence Society), I started a membership drive to create a broad membership basis for our new society, which, as a previous council (NNC), only had sponsoring societies. As a result of those initial efforts we now have a global membership of over 6,000 members.

As ***VP of Finances of the IEEE NNC/NNS/CIS*** for 13 years (over the last 17 years), I managed the budget of our council/society, leading to the creation of a net worth of over $6 MM, while supporting a broad array of educational, technical, professional development, and scientific activities.

As ***Conference*** / ***Program Chair*** for seven IEEE CIS (and five non-IEEE) sponsored conferences over the past 28 years, I organized and supervised the review process of thousands of papers, to ensure the conferences' high quality technical content.

Academic / Scientific Activities (Elsevier)

As ***Chair*** of the Scientific Committee of the European Centre of Soft Computing (ECSC), I am leveraging my SC experience to guide and support the scientific progress and technical growth of the ECSC.

As the ***Editor-in Chief*** of the International Journal of Approximate Reasoning (IJAR) for 13 years (99 issues) I shaped the scope of the journal to reach a broad scientific audience in the Artificial Intelligence, Computational Intelligence, and Computer Science communities

Technical and Scientific Activities (GE)

Over the past six years, I played the role of Chief Scientist in the Computing and Decision Sciences (CDS) Global Technology Office at GE Global Research (GE GR). This role was officially recognized in September 2007, when GE created the Technical Career Path, consisting of five positions culminating with the role of Chief Scientist (a controlled position.) As one of the two ***Chief Scientists*** in CDS**,** I created a process to evaluate and rank all future high-risk, high-impact proposals submitted for corporate funding at GE GR, and originated and shaped many high-impact projects.

As ***senior scientist*** in the Industrial Artificial Intelligence Laboratory, I mentored over 60% of the lab members, including the lab manager.
As ***project leader*** in the Computing and Decision Sciences Global Technology Office, I formulated the problem, defined the metrics, shaped the technical approach, and supervised the executions of many successful projects at GE Global Research – see sample below.

Selected Projects at GE Global Research

- **Prognostics and Health Management for a wide variety of assets: CT, MRI, Locomotives, Aircrafts, Aircraft Engines, Compressors, etc. (GE Healthcare, GE, Rail, GE Aviation, GE Oil & Gas, Lockheed Martin)** [2000- present]
  Problem: Productivity enhancement in the Contractual Service Agreement (CSA) of GE equipment has a direct impact on the profitability of such contracts. We need to provide fleet-wide remote monitoring of each unit and detect any deviation from their normal operating behavior. Once a change is detected, we need to determine the (incipient) fault mode, and estimate the equipment remaining useful life under nominal or de-rated future loads. Finally, we want to assess the need for immediate fault accommodation actions to guarantee safe operations, and to optimize the service/maintenance plan to minimize cost, time, and operational impact. This has a broad applicability over several GE businesses.
  Approach: We have developed a broad array of platform-independent algorithms, ranging from the ensemble of anomaly detectors using categorical or time-series data (based on unsupervised learning techniques to discover normal and abnormal structures), to supervised machine learning techniques for classification of fault modes, to predictive models based on AI, Soft Computing, and statistics to forecast remaining useful life. The optimization techniques are a combination of evolutionary algorithms with more traditional mathematical programming techniques.
  Results: Many ongoing projects, at different technology maturity levels with each of the GE businesses listed above**.**
  IP: 21 patents issued [4 in Anomaly Detection (7,317,994, 7,667,827, 7,937,334, 7,958,062,); 7 in Diagnostics (6,105,149, 6,442,542, 6,609,217, 6,643,799, 7,103,509, 7,756,678, 7,814,034); 13 in Prognostics (5,942,689, 6,405,140, 6,466,877, 6,498,993, 6,519,534, 6,522,978,6,542,852, 7,395,188, 7,509,235, 7,548,830, 7,725,293)] , 10+ patents pending
- **Optimal Management of Coal-Fired Boilers for Power Generation (GE Energy)** [2003-07]
  Problem: In a typical industrial power plant, such as coal-fired boiler / steam turbine combination, for each load condition we need to define the optimal operating point for the plant. This consists of a vector of input settings that influence combustion (e.g. air, fuel and flow settings), and the resultant NOx emissions, Heat Rate (inversely related to efficiency), and load characteristics. Reliable prediction of emissions, efficiency and load via multi-model fusion is critical to the efficient and environmentally sound management of the combustion process. Equally important is the generation of the Pareto set of operating points that exemplify different tradeoffs between Heat Rate and NOx emissions.
  Approach: We developed a novel model-based multi-objective optimization and decision-making approach to model-predictive decision-making. The approach integrates predictive modeling based on an ensemble of neural networks, optimization based on multi-objective evolutionary algorithms, and decision-making based on Pareto frontier techniques. The predictive models are adaptive, and continually update themselves to reflect with high fidelity the gradually changing underlying system dynamics.
  Results: The resulting software product, entitled Knowledge^3, is currently being sold by GE Energy (http://www.gepower.com/prod_serv/products/oc/en/downloads/ge_4256_l.pdf)
  IP: 1 patent issued (7,389,151), 2 patents pending
- **Portfolio Optimization/Rebalancing for investment funds (GE Asset Management)** [2002-06]
  Problem: A principal challenge in modern computational finance is efficient portfolio design – portfolio optimization followed by decision-making. Optimization based on even the widely used Markowitz two-objective mean-variance approach becomes computationally challenging for real-life portfolios. Practical portfolio design introduces further complexity as it requires the optimization of multiple return and risk measures subject to a variety of risk and regulatory constraints. Further, some of these measures may be nonlinear and non-convex, presenting a daunting challenge to conventional optimization approaches.
  Approach: We developed a powerful hybrid multi-objective optimization approach that combines

evolutionary computation with linear programming to simultaneously maximize these return measures, minimize these risk measures, and identify the efficient frontier of portfolios that satisfy all constraints. We also introduced a novel interactive graphical decision-making architecture that allows the decision-maker to quickly down-select to a small subset of efficient portfolios.
Results: Software and Process transitioned to GE Asset Management for production use in 2005-06
IP: 4 patent issued (7,469,228, 7,536,364, 7,542,932, 7,630,928), 2 patents pending

- **Automated Term-Life and Long Term Care Insurance Underwriting (GE Financial Assurance, now Genworth Financial).** [2000-2003]
  Problem: Insurance underwriting is a complex decision-making task that is usually performed by trained individuals. An underwriter must evaluate each insurance application in terms of its potential risk for generating a claim, such as mortality in the case of term life insurance. An application is compared against standards adopted by the insurance company, which are derived from actuarial principles related to mortality. Based on this comparison, the application is classified into one of the risk categories available for the type of insurance requested by the applicant. The accept/reject decision is also part of this risk classification, since risks above a certain tolerance level will typically be rejected. The estimated risk, in conjunction with other factors such as gender, age, and policy face value, determines the appropriate premium for the insurance policy. All other factors being equal, higher risk entails higher premium. Genworth Financial wanted to automate this process to improve consistency and reduce the number of incorrect placements.
  Approach: For each insurance product, we developed a fuzzy logic based classifiers whose parameters were determined by an evolutionary algorithm to minimize the cost of misclassification, using a training set of 3,000 historical cases.
  Results: Software and Process transitioned to Genworth Financial for production use in 2004
  IP: 11USPTO patents issued (8,005,603,7,383,239, 7,567,914, 7,630,910, 7,801,748 7,813,945, 7,818,186, 7,844,476. 7,844,477, 7,895,062, 7,899,688); 6 patents pending
- **Demographic Profile of Preferred Customers for Target Marketing (GE Financial Assurance – Long Term Care, now Genworth Financial)** [1997-1999]
  Results: Software was used to filter production mail files for over two years before transitioning it to GEFA Long Term Care (now Genworth Financial)
- **Automated Mortgage Collateral Evaluation (GE Mortgages)** [1994-1995]
  Results: The project was successfully tested on 10 counties in Southern California. Due to business downturn, it was not transferred to the business.
  IP: 4 patents issued (6,115,694, 6,141,648, 6,609,217, 6,748,369)
- **Paper web breakage prediction (GE Industrial Systems / GE Trading)** [1994-1998]
  Problem: Paper mills have enormous size, often times a hundred meters in length or more. Making paper involves running miles of wet and dry webs over and between large cylinders that convert pulp into the final product. The speed of the web can reach 60 mph. Under those conditions, it is not surprising that the web breaks on a daily basis. However, breakage is not always well understood and even harder to predict. Our goal was to predict wet-end breaks with enough time to make process corrections and prevent the break.
  Results: Software prototype (alpha) was built and tested on four different paper machines to prove feasibility and secure IP's.
  IP: 7 patents issued (5,942,689, 6,405,140, 6,466,877, 6,498,993, 6,519,534, 6,522,978 , 6,542,852)
- **Automated Train Controller (GE Rail)** [1993-1996]
  Results: Software prototype (alpha) was built and tested on simulated train runs to prove feasibility and secure IP's.
  IP: 4 patents issued (5,983,144, 5,995,737, 6,243,694, 6,760,712)
- **Automated Control for Cement Making (GE Industrial Systems / GE Trading)** [1994-1998]
  Results: Control technology transferred to a IMA, a Finnish company that manufactures a specialized mass spectrograph sensor to analyze cement plant raw materials
  IP: 5 patents issued (6,113,256, 6,120,172 , 6,120,173, 6,668,201, 7,308,339)
- **Fuzzy Logic Control for Aircraft Engines, Power Electronics, Steam Turbines, Autonomous Vehicle (GE Aviation, GE Energy, Lockheed Martin)** [1992-1995]
  Results: Many hardware and software prototypes were built to prove feasibility and secure IP's
  IP: 5 patents issued (5,436,839, 5,517,424, 5,534,766, 5,806,052, 6,078,911)
- **Uncertainty Management in Automated Reasoning Systems (GE Aerospace, DARPA, Rome**

Labs, GE Financial Assurance) [1985-1995]
IP: 5 patents issued (4,860,213, 5,058,033, 6,078,911, 7,801,748, 7,818,186)

Invited Talks by P. Bonissone

2011 *(1 Plenary talk, 2 Panel Session, 1 Tutorial Talk, 2 invited Talks)*

1. **Invited Speaker: "***Soft Computing in the Design of Anomaly Detection Models",* Data Mining for service and Maintenance Workshop in conjunction with KDD 2011, San Diego, CA, Aug 21-24, 2011
2. **Plenary Speaker: "***Soft Computing in Prognostics and Health Management (PHM) Applications: a Case Study in Anomaly Detection",* 2011 IEEE Conference on Fuzzy Systems (FUZZ-IEEE 2011), Taipei, Taiwan, June 28-30, 2011.
3. **Panel Speaker: "***The Evolution of Soft Computing",* 2011 IEEE Conference on Fuzzy Systems (FUZZ-IEEE 2011), Taipei, Taiwan, June 28-30, 2011
4. **Panel Speaker:** *"Soft Computing Challenges and Future Directions in Society and Industry",* World Conference on Soft Computing (WConSC), San Francisco State University, San Francisco CA, May 23-26, 2011.
5. **Invited Speaker: "***Soft Computing in Prognostics and Health Management (PHM) Applications: a Case Study in Anomaly Detection",* International Workshop on New Trends of Computational Intelligence in Engineering Informatics*,* IEEE CIS Italian Chapter, Provincia di Salerno, Salerno, Italy*,* May 5, 2011.
6. **Tutorial Speaker: "**Multi-Criteria Decision Making: The Intersection of Search, Preference Tradeoff, and Interaction Visualization Processes", IEEE Symposium on Computational Intelligence in Multi-Criteria Decision-Making (IEEE MCDM 2011), Paris, France, April 12, 2011

2010 *(1 Keynote talk, 1 Tutorial, 2 Panels)*

1. **Tutorial Speaker: "** *Information Fusion for PHM Models (Anomaly Detection, Diagnostics, and Prognostics)*", *PHM 2010*, Portland, OR, October 10-14, 2010 – (pdf) *[presented by Neil Eklund]*
2. **Keynote Speaker: "***Soft Computing in Anomaly Detection***",** Conference on Intelligent Data Understanding (CIDU 2010), Mountain View, CA, October 5-7, 2010. (pdf)
3. **Panel Speaker: "***Computational Intelligence Applications at GE*", Panel on Computational Intelligence in Industry, 2010 IEEE Word Congress on Computational Intelligence (WCCI 2010), Barcelona, Spain, July 18-23, 2010.
4. **Panel Speaker: "***The need for Interpretability in SC models*", Panel on Computational Intelligence and Knowledge based System Interpretability, 2010 IEEE Word Congress on Computational Intelligence (WCCI 2010), Barcelona, Spain, July 18-23, 2010.

2009 *(1 Keynote talk, 1 Tutorial, 3 Seminar)*

1. **Keynote Speaker: "***Computational Intelligence in PHM***",** 9th International Conference on Intelligent Systems Design and Applications (ISDA 2009), Pisa, Italy, Nov 30-Dec. 2, 2009.
2. **Seminar Speaker: "***The role of Soft Computing in Multi-Criteria Decision Making"*, CS Dept. University of Murcia, Spain, Nov 25, 2009
3. **Seminar Speaker: "***Multi-Criteria Decision Making: The Intersection of Search, Preference Tradeoff, and Interaction Visualization Processes*", DLP, IEEE Schenectady Section, Oct 23, 2009.
4. **Seminar Speaker: "**Multi-Criteria Decision Making: The Intersection of Search, Preference Tradeoff, and Interaction Visualization Processes", DSES Dept., RPI, Troy, NY, April 14, 2009.
5. **Tutorial Speaker: "**Multi-Criteria Decision Making: The Intersection of Search, Preference Tradeoff, and Interaction Visualization Processes", IEEE Symposium on Computational Intelligence in Multi-Criteria Decision-Making (IEEE MCDM 2009), Nashville, TN, Mar. 30-Apr. 2, 2009, doi 10.1109/MCDM.2009.4938820 (video–part1; video-part2; video-part3)

2008 *(4 Keynote Speeches, 1 Invited talk, 2 Seminar, 1 Panel)*

1. **Keynote Speaker: "***Soft Computing PHM Applications*", 5th International Conference on Electrical Engineering, Computer Science and Automatic Control (CCE-2008), Mexico City, Mexico, Nov 12-14, 2008.
2. **Keynote Speaker:** *"Computational Intelligence in Prognostics and Health Management (PHM): Applications in Rail and Industrial Asset Management",* International Workshop on Computational Intelligence in Security for Information Systems (CISIS 2008), Genova, Italy, Oct 23-24, 2008.

3. **Keynote Speaker**: "*Soft Computing PHM Applications*", 8th International FLINS Conference on Applied Artificial Intelligence (FLINS'08), Madrid, Spain, September 21-24, 2008, (pdf)
4. **Invited Talk:** *"Design of Local Fuzzy Models",* NASA Conference for Intelligent Data Understanding (NASA CIDU), September 9-10, 2008. (pdf)
5. **Panelist:** *Industrial Applications of Computational Intelligence,* WCCI 2008 Hong Kong, China, June 1-6, 2008
6. **Seminar**: "*Design of Local Fuzzy Models Using Evolutionary Algorithms: An Application to Asset Utilization"*, CS Dept. University of Murcia, Spain, April 3, 2008
7. **Seminar**: "*Soft Computing Applications to Prognostics and Health Management (PHM): Leveraging Field Data and Domain Knowledge"*, AI Research Institute (IIIA-CSIC), Barcelona, Spain, March 31, 2008
8. **Keynote Speaker:** "*Industrial and Commercial Applications of Computational Intelligence*", 2008 IST Graduate Symposium, Penn State's College of Information Sciences and Technology, Jan 31-Feb 1, 2008.

2007 *(4 Keynote Speeches, 3 Invited Talk, 4 Seminars)*

1. **Keynote Speaker**: "*Industrial and Commercial Applications of Computational Intelligence*", 8th International Conference on Intelligent Data Engineering and Automated Learning (IDEAL'07), Birmingham, UK, December 16-19, 2007
2. **Seminar**: "*Computational Intelligence in Prognostics and Health Management (PHM) Management"*, Center for Advanced Life Cycle Engineering (CALCE), College Park, MD, October 30, 2007
3. **Invited Talk:** *"GE Global Research Industrial AI Activities in PHM",* 4th International HUMS User Conference, Winchester, WIN, UK, Sept 18-20, 2007.
4. **Seminar**: "*Knowledge, Time and Decisions: A Framework for Soft Computing Applications in Prognostics and Health Management (PHM)"*, CIS Distinguished Lecture, Future Directions in Soft Computing - First Summer Course, European Centre for Soft Computing, (ECSC), Oviedo, Spain, July 13, 2007
5. **Seminar**: "*Design of Local Fuzzy Models Using Evolutionary Algorithms"*, Future Directions in Soft Computing - First Summer Course, European Centre for Soft Computing, (ECSC), Oviedo, Spain July 12, 2007
6. **Keynote Speaker**: "*Soft Computing applications to Prognostics and Health Management (PHM): Leveraging field data and domain knowledge"*, 9th International Work-Conference on Artificial Neural Networks (IWANN 2007), pp. 928-939, San Sebastián (Spain), June 20-22, 2007
7. **Invited Talk:** *"PHM Applications based on AI and Soft Computing Techniques",* First Prognostics and Health Management Conference at GE Global Research, Niskayuna, NY, May 30, 2007.
8. **Invited Talk:** *"PHM Applications at General Electric based on AI and Soft Computing Techniques",* Boeing IVHM Forum, St. Louis, MO., May 16, 2007.
9. **Seminar Speaker**: "*Soft Computing Applications in Prognostics and Health Management (PHM): A Time and Knowledge Framework",* (in Italian), CS Department, University of Salerno, April 2007
10. **Keynote Speaker**: "*Multi-Criteria Decision-Making: The Intersection of Search, Preference Tradeoff, and Interaction Visualization Processes*", First IEEE Symposium on Computational Intelligence in Multi-Criteria Decision-Making (MCDM 2007), Honolulu, Hawaii, April 2, 2007
11. **Keynote Speaker**: "*A Framework for Soft Computing PHM Applications*", V Congreso Español sobre Metaheurísticas, Algoritmos Evolutivos y Bioinspirados (MAEB 2007), (in Spanish) Puerto de La Cruz, Tenerife, Spain, February 14-16, 2007

2006 *(4 Keynote Speeches, 2 Invited Talks, 4 Seminars, 1 Panel)*

1. **Keynote Speaker**: *"Design of Local Fuzzy Models Using Evolutionary Algorithms",* Third Latin-American Summer School on Computational Intelligence, CIS Distinguished Lecture, *EVIC 2006*, Santiago de Chile, Chile, December 15, 2006
2. **Keynote Speaker**: *"Knowledge, Time, and Decisions: A Framework for Soft Computing Applications", EVIC 2006,* Santiago de Chile, Chile, December 13, 2006
3. **Invited Speaker**: *"Evolving Fuzzy Models to Identifying the Best and Worst Units in a Fleet", INFORMS 2006*, Pittsburgh, PA, Nov 6, 2006
4. **Seminar**: *"Evolving Local Fuzzy Models to Adapt in a Dynamic Environment: An Example in*

Asset Management" (in Spanish), AI Research Institute (IIIA-CSIC), Barcelona, Spain, October, 2006

5. **Keynote Speaker**: *"Evolving Local Fuzzy Models to Adapt in a Dynamic Environment: An Example in Asset Management", ICNC-FSKD 2006*, Xi'An, China, September 27, 2006
6. **Keynote Speaker**: *"Domain Knowledge and Decision Time: A Framework for Soft Computing Applications", 2006 International Symposium on Evolving Fuzzy Systems (EFS 2006)*, Ambleside, Lake District, UK. September 7-9, 2006
7. **Seminar**: *"Soft Computing: Combining Reasoning and Search to Design and Maintain SC Models"* (in Italian), CS Department, University of Salerno, June 2006
8. **Invited Speaker:** *"Soft Computing: Combining Reasoning and Search to Design and Maintain SC Models",* CIS Distinguished Lecture, CIS Montreal Chapter, Montreal, Canada, 2006
9. **Panelist**: *"Prognostics and Health management at GE",* National Defense Industrial Association (NDIA), Miami, FL, April 17, 2006, (pdf)
10. **Seminar:** *"Time, Knowledge, and Decisions: When, How, and What: A Framework for Computational Intelligence Applications"* (in Spanish), CS Department, Universidad Politécnica de Madrid (UPM), Madrid, Spain, March 2006
11. **Seminar:** *"Time, Knowledge, and Decisions: When, How, and What: A Framework for Computational Intelligence Applications",* CMU Robotics Institute, Pittsburgh, PA, Feb. 23, 2006

2005 *(4 Keynote Speeches, 1 Seminar, 1 Panel)*

1. **Seminar:** *"Time, Knowledge, and Decisions: When, How, and What: A Framework for Computational Intelligence Applications",* CDS Seminar, GE Global Research, Niskayuna, NY, December 1, 2005
2. **Keynote Speaker**: *"Soft Computing: Combining Reasoning and Search to Design and Maintain SC Models",* MICAI 2005, Monterrey, Mexico, November 14-18, 2005
3. **Keynote Speaker**: *"Computational Intelligence: Combining Reasoning and Search to Design and Maintain CI Models"* (in Spanish), CIS Distinguished Lecture, Simposio de Inteligencia Computacional (SICO 2005) CEDI'2005 (S16), Granada, Spain, September 13, 2005
4. **Panelist**: *"Technology Transfer for Computational Intelligence",* EUSFLAT 2005, Barcelona, September 7-9, 2005
5. **Keynote Speaker**: "Fuzzy Evolutionary Systems: First Steps Toward Supporting Model Lifecycle", NAFIPS 2005, Ann Arbor, MI, June 22-25, 2005 (pdf-Abstract), doi 10.1109/NAFIPS.2005.1548600
6. **Keynote Speaker**: "An Evolutionary Process for Designing and Maintaining a Fuzzy Instance-based Model (FIM)", CIS Distinguished Lecture, GFS 2005, Granada, Spain, March 17-19, 2005

2004 *(2 Keynote Speeches, 1 Seminar)*

1. **Keynote Speaker**: *"Development and Maintenance of Fuzzy Models in Real-World Applications",* Second International Conference on Soft Methods in Probability and Statistics (SMPS), Oviedo, Spain, September 2-4, 2004
2. **Keynote Speaker**: "*Evolutionary Algorithms + Domain Knowledge = Real World Evolutionary Computation - Using Knowledge and Reasoning to Control Search and Vice-versa*", CIS Distinguished Lecture, 7th International Conference on Artificial Intelligence and Soft Computing (ICAISC'04), Zakopane, Poland, June 7-11, 2004
3. **Seminar:** *"Soft Computing: A Common Framework to Represent Meta-heuristics"*, CIS Distinguished Lecture, IEEE CIS Chapter, Buenos Aires, Argentina, 11 March 2004

2003 *(3 Keynote Speeches)*

1. **Keynote Speaker**: *"Soft Computing: A Common Framework to Represent Meta-heuristics*, Artificial Neural Networks In Engineering (ANNIE '03) , St. Louis, MO, Nov. 2-5, 2003
2. **Keynote Speaker**: *"Meta-Heuristics and the No Free Lunch Theorem: Using Knowledge & Reasoning to Control Search and Vice-versa*", IEEE International Workshop on Soft Computing in Industrial Applications (SMCia/03), SUNY Binghamton, NY, June 23-25, 2003
3. **Keynote Speaker**: "*Soft Computing and Meta-heuristics: Using Knowledge and Reasoning to Control Search and Vice-versa*", III Congreso Español sobre Metaheurísticas, Algoritmos Evolutivos y Bioinspirados (MAEB 2003), (in Spanish), Gijón Asturias, Spain, 2003

2002 *(3 Keynote Speeches, 1 Seminar)*

1 **Seminar:** *"Hybrid Soft Computing Systems at GE: Prediction and Classification Applications*",

BISC Seminar, EECS Dept. University of California, Berkeley, Oct. 23, 2002.

2. **Keynote Speaker**: "*Hybrid Soft Computing Systems at General Electric: Prediction and Classification Applications"*, 2002 European Symp. on Intelligent Technologies, Hybrid Systems & their implementation on Smart Adaptive Systems, (EUNITE'02) Algarve, Portugal, 19-21 Sept. 2002
3. **Keynote Speaker**: "Hybrid Soft Computing for Classification and Prediction Applications", *Soft-Ware 2002: Computing in an Imperfect World*. pp. 352-353, Belfast, Northern Ireland, April 8-10, 2002.
4. **Keynote Speaker**: "*Development and Maintenance of Soft Computing Models for Decision Making Applications"*, 2002 IEEE World Congress Computational Intelligence (WCCI'02), Honolulu, HI, May 12-17, 2002

2000 *(1 Keynote Speech)*

1. **Keynote Speaker**: *"Hybrid Soft Computing Systems: Where Are We Going?",* 14th European Conference on Artificial Intelligence (ECAI 2000), Berlin, Germany, 20-25 August 2000, (ppt)

1998 *(1 Keynote Speech)*

1. **Keynote Speaker**: *"Soft Computing: The Synergistic Interaction of Fuzzy, Neural, and Evolutionary Computation",* 5th International Workshop Fuzzy-Neuro-Systems '98 (FNS '98), Munich, Germany, March 19-20, 1998

1994 *(1 Keynote Speech)*

1. **Keynote Plenary Speaker**: *"Fuzzy Logic Controllers: An Industrial Reality",* 1st Word Congress on Computational Intelligence (WCCI'94), Orlando, FL, 1994

1993 *(1 Keynote Speech, 1 Panel)*

1. **Keynote Plenary Speaker**: "Fuzzy Logic Controllers: From Development to Deployment*",* International Conference on Neural Networks (ICNN '93), San Francisco, CA, March 28-April 1, 1993
2. **Panelist**: *"Fuzzy Logics and AI", International Joint Conference on Artificial Intelligence (*IJCAI'93*)*, August 1993

1991 *(1 Keynote Speech)*

1. **Keynote Plenary Speaker**: *"Approximate Reasoning Systems: A Personal Perspective",* American Association for Artificial Intelligence (AAAI'91), Anaheim, CA, July 1991

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1. *Process for determining a confidence factor for insurance underwriting suitable for use by an automated system,* P. Bonissone, W. Cheetham, US Patent 8,005,693, (August 23, 2011)
2. *Method and system of creating health operating envelope for dynamic systems by unsupervised learning of a sequence of discrete event codes,* W. Yan, A. Varma, P. Bonissone, US Patent 7,958,062, (June 7, 2011)
3. *System and method for defining normal operating regions and identifying anomalous behavior of units within a fleet, operating in a complex, dynamic environment,* P. Bonissone, W. Yan, N. Iyer, K. Goebel, A. Varma, US Patent 7,937,334, (May 3, 2011)
4. *Process for optimization of insurance underwriting suitable for use by an automated system,* P. Bonissone, R. Messmer, A. Patterson, D. Yang, M. Pavese, R. Subbu, K. Aggour, US Patent 7,899,688, (March 1, 2011)
5. *System for optimization of insurance underwriting suitable for use by an automated system,* P. Bonissone, R. Messmer, A. Patterson, D. Yang, M. Pavese, R. Subbu, K. Aggour, US Patent 7,895,062, (February 22, 2011)
6. *Process for rule-based insurance underwriting suitable for use by an automated system*, P. Bonissone, R. Messmer, M. Durham, D. Yang, M. Pavese, D. Russell, US Patent 7,844,477, (November 30, 2010)
7. *Process for case-based insurance underwriting suitable for use by an automated system*, P. Bonissone, R. Messmer, D. Yang, M. Pavese, A. Patterson, A. Mogro-Campero, A. Varma, M. Durham, D. Russell, R Subbu, US Patent 7,844,476, (November 30, 2010)
8. *System for determining a confidence factor for insurance underwriting suitable for use by an automated system,* P. Bonissone, W. Cheetham, US Patent 7,818,186, (October 19, 2010)
9. *Method and system for automatically developing a fault classification system by segregation of kernels in time series data,* N. Eklund, W. Yan, A. Varma, P. Bonissone, US Patent 7,814,034, (October 12, 2010)
10. *System and process for multivariate adaptive regression splines classification for insurance underwriting suitable for use by an automated system*, P. Bonissone, R. Messmer, R. Subbu, W. Yan, A. Chakraborty, US Patent 7,813,945, (October 12, 2010)
11. *System and process for detecting outliers for insurance underwriting suitable for use by an automated system,* P. Bonissone, N. Iyer, US Patent 7,801,748, (September 21, 2010)
12. *System and Method For Advanced Condition Monitoring of an Asset System*, P. Bonissone, J. Hershey, R. Mitchell, R. Subbu. A. Taware, X. Hu, US Patent 7,756,678 (July 13, 2010)
13. *System And Method For Equipment Life Estimation*, P. Bonissone, F. Xue, A. Varma, K. Goebel, W. Yan, N. Eklund, US Patent 7,725,293 (May 25, 2010)
14. *System and Method for remote monitoring of vibrations in machines*, M. Nelson, N. Iyer; J. Hershey, C. Seeley, P. Bonissone, F. Goebel, (182592-1), US Patent 7,667,827 (Feb 23, 2010)
15. *Systems and methods for multi-objective portfolio analysis and decision-making using visualization techniques*, P. Bonissone, S. Bollapragada, K. Chalermkraivuth, N. Eklund, N. Iyer, R. Subbu, US Patent 7,630,928 (Dec 8, 2009)
16. *Systems for case-based insurance underwriting suitable for use by an automated system*, P. Bonissone, R. Messmer, D. Yang, M. Pavese, A. Neff-Patterson, A. Mogro-Campero, A. Varma, M. Durham, D. Russell, R. Subbu, US Patent 7,630,910 (Dec 8, 2009)
17. *System and process for dominance classification for insurance underwriting suitable for use by an automated system*, P. Bonissone, N. Iyer, US Patent 7,567,914 (July 28, 2009)
18. *System And Method For Equipment Life Estimation*, K. Goebel, P. Bonissone, W. Yan, N. Eklund, F. Xue, US Patent 7,548,830 (June 16, 2009)
19. *Systems and methods for multi-objective portfolio optimization,* K. Chalermkraivuth, S. Bollapragada, P. Bonissone, M. Clark, N. Eklund, N. White N. Iyer, R. Subbu, US Patent 7,542,932 (June 2, 2009)
20. *Method and system for performing model-based multi-objective asset optimization and decision-making*, K. Chalermkraivuth, S. Bollapragada, P. Bonissone, M. Clark, N. Eklund, N. Iyer, R. Subbu, US Patent 7,536,364 (May 19, 2009), (WO2005081902)
21. *Method and system for forecasting reliability of assets*, (156003-1), P. Bonissone, K. Aggour, A. Varma, US Patent No. 7,509,235, (March 24, 2009).

22. *Systems and methods for efficient frontier supplementation in multi-objective portfolio analysis,* P. Bonissone, S. Bollapragada, C. Chalermkraivuth, N. Eklund, N. Iyer, R; Subbu, US Patent No. 7,469,228 (Dec 23, 2008)
23. *System and Method for Equipment Life Estimation* (205772), K. Goebel, P. Bonissone, W. Yan, N. Eklund, F. Xue, H. Qiu, US Patent No. 7,395,188 , (July 1, 2008)
24. *Systems and methods for multi-level optimizing control systems for boilers,* V. Badami, R. Subbu**,** A. Taware, P. Bonissone, N. Widmer, US Patent No. 7,389,151 (June 17, 2008)
25. *System and process for a fusion classification for insurance underwriting suitable for use by an automated system,* P. Bonissone*,* K. Aggour, R. Subbu, W. Yan, N. Iyer*,* A. Chakraborty, US Patent No. 7,383,239 (Jun 8, 2008).
26. *Method and Apparatus for signal signature analysis for event detection in rotating machinery*, N. Iyer, J. Hershey, J. Aragones, K. Goebel, W. Yan, P. Bonissone, C Hatch, US Patent No. 7,317,994 (Jan 8, 2008).
27. *System and Method for tuning a raw mix proportioning controller*, P. Bonissone, Y-T Chen, US Patent No. 7,308,339 (Dec 11, 2007).
28. *System and Method for predicting component failures in large systems*, R.Shah, V.Rajiv, M. Osborn, M. Asati, **P. Bonissone,** US Patent No. 7,103,509 (September 5, 2006).
29. *Automatic train handling controller,* **P. Bonissone**, Y-T Chen, P. Khedkar, P. Houpt, J. Schneiter, US Patent No. 6,760,712 (Jul, 6, 2004)
30. *Method and system for automated property valuation,* P. Khedkar, P. Bonissone, US Patent No. 6,748,369 (Jun, 8, 2004)
31. *System and method for tuning a raw mix proportioning controller,* P. Bonissone, Yu-To Chen, US Patent No. 6,668,201 (Dec. 23, 2003)
32. *System and method for diagnosing and validating a machine using waveform data*, P. Bonissone, Y-T Chen, V. Ramani, R. Shah, J. Johnson, P. Steen, and R. Ramachandran, US Patent No. 6,643,799 (Nov. 4, 2003)
33. *System and method for diagnosing and validating a machine over a network using waveform data,* P. Bonissone, Y-T Chen, V. Ramani, R. Shah, J. Johnson, P. Steen, and R. Ramachandran, US Patent No. 6,609,217 (Aug. 19, 2003)
34. *Methods and systems for automated property valuation,* P. Khedkar, P. Bonissone, and D. Golibersuch, US Patent No. 6,609,118 (Aug. 19, 2003)
35. *System and method for paper web time-to-break prediction,* Yu-To Chen, P. Bonissone, US Patent No. 6,542,852 (Apr. 1, 2003)
36. *Paper web breakage prediction using principal components analysis and classification and regression trees*, Yu-To Chen, P. Bonissone, US Patent No. 6,522,978 (Feb. 18, 2003)
37. *Paper web breakage prediction using bootstrap aggregation of classification and regression trees*, Yu-To Chen, P. Bonissone, US Patent No. 6,519,534 (Feb. 11, 2003)
38. *Paper web breakage prediction using bootstrap aggregation of classification and regression trees*, Yu-To Chen, P. Bonissone, US Patent No. 6,498,993 (Dec. 24, 2002)
39. *Paper Web Breakage Prediction Using Principal Components Analysis and Classification and Regression Trees*, Yu-To Chen, P. Bonissone, US Patent No. 6,466,877 (Oct. 15, 2002)
40. *Diagnostic System with Learning Capabilities* , V. Ramani, R. Shah, R. Ramachandran, P. Bonissone, Yu-To Chen, P. Steen, and J. Johnson, US Patent No. 6,442,542 (Aug. 7, 2002)
41. *System and method for paper web time-to-break prediction*, Yu-To Chen, P. Bonissone, US Patent No. 6,405,140 (Jun. 11, 2002)
42. *System and Method for Generating a Fuel-Optimal Reference Velocity Profile for a Rail-Based Transportation Handling Controller,* P. Bonissone, Y-T Chen, P. Khedkar, P. Houpt, J. Schneiter, US Patent No. 6,243,694 (Jun. 5, 2001)
43. *Method for Estimating the Value of Real Property,* W. Cheetham, P. Bonissone,

US Patent No. 6,178,406 (Jan. 23, 2001)

44. *Method for Estimating the Price per Square Foot Value of Real Property*, P. Bonissone, W. Cheetham,
US Patent No. 6,141,648 (Oct. 31, 2000)
45. *Infrared non-contact temperature measurement for household appliances*, W. Whipple III, R. Alley; P. Bonissone, M. Dausch, and V. Badami,
US Patent No. 6,132,084 (Oct. 17, 2000)
46. *Compilation of Rule Base for Fuzzy Logic Control*, P. Bonissone, J. Comly, and M. Dausch,
US Patent No. 6,078,911 (Jun. 20, 2000)
47. *System and Method for Providing Raw Mix Proportioning Control in a Cement Plant with Gradient-Based Predictive Controller*, P. Bonissone, and Yu-To Chen,
US Patent No. 6,120,173 (Sept. 19, 2000)
48. *System and Method for Providing Raw Mix Proportioning Control in a Cement Plant*, Yu-To Chen, P. Bonissone,
US Patent No. 6,120,172 (Sept. 19, 2000)
49. *Method for Validating Specified Prices of Real Estate*, W. Cheetham, P. Bonissone,
US Patent No. 6,115,694 (Sept. 5, 2000)
50. *System and Method for Providing Raw Mix Proportioning Control in a Cement Plant with a Fuzzy Logic Supervisory Control*, P. Bonissone, Yu-To Chen,
US Patent No. 6,113,256 (Sept. 5, 2000)
51. *System and Method for Diagnosing and Validating a Machine Using Waveform Data*, P. Bonissone, Yu-To Chen, V. Ramani, R. Shah, J. Johnson, P. Steen, and R. Ramachandran,
US Patent No. 6,105,149 (Aug. 15, 2000)
52. *System and Method for Tuning a Rail-based Transportation System Speed Controller*, P. Bonissone, Yu-To Chen and P. Khedkar, US Patent No. 5,995,737 (Nov. 30, 1999)
53. *System and Method for Tuning Look-ahead Error Measurements in a Rail-based Transportation Handling Controller*, P. Bonissone, Yu-To Chen and P. Khedkar,
US Patent No. 5,983,144 (Nov. 9, 1999) – *[Forward references: 6]*
54. *System and Method for Predicting a Web Break in a Paper Machine*, P. Bonissone, Yu-To Chen and P. Khedkar, US Patent No. 5,942,689 (Aug. 24, 1999) – *[Forward references: 8]*
55. *Clothes Fabric Type Blend Detection Method and Apparatus*, V. Badami, P. Bonissone, and M. Dausch, US Patent No. 5,897,672 (Apr. 27, 1999) – *[Forward references: 6]*
56. *Fuzzy Hierarchical Controller for a Turboshaft Engine*, P. Bonissone, K. Chiang, M. Dausch, and J. Comly, US Patent No. 5,806,052 (Sept. 8, 1998) – *[Forward references: 9]*
57. *Fuzzy Logic Power Supply Controller*, P. Bonissone, M. Schutten, and K. Chiang,
US Patent No. 5,534,766 (July 9, 1996) – *[Forward references: 5]*
58. *Steam Turbine Fuzzy Logic Cyclic Control Method and Apparatus Thereof*, K. Marcelle, K. Chiang, P. Houpt, P. Bonissone, and J. Weiss,
US Patent No. 5,517,424 (May 14, 1996) – *[Forward references: 16]*
59. *Navigation module for a semi-autonomous vehicle*, M. Dausch, B. Carey, and P. Bonissone,
US Patent No. 5,436,839 (July 25,1995) – *[Forward references: 4]*
60. *A Real-Time System for Reasoning With Uncertainty*, P. Bonissone, L. Pfau,
US Patent Number 5,058,033 (October 15, 1991) – *[Forward references: 25]*
61. *A Reasoning System for Reasoning with Uncertainty*, P. Bonissone,
US Patent Number 4,860,213 (August 22, 1989) – *[Forward references: 30]*

To update Patent Issued List, click below:
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1. ***Semi-Automated and Inter-Active System and Method for Analyzing Patent Landscapes,*** V. Avasarala, J. Hershey; A. Varma, P. Bonissone, PUB_20100287478, published Nov 11, 2010
2. ***System and Method For Advanced Condition Monitoring Of An Asset System***, R. Subbu, J.R. Mitchell, J. Hershey, X. Hu, J.R. Mitchell, A. Taware, P. Bonissone, PUB_20090299695 published December 3, 2009
3. ***System And Method For Advanced Condition Monitoring Of An Asset System***, X. Hu, J.

Hershey, J.R. Mitchell, R. Subbu, A. Taware, P. Bonissone, PUB_20090295561 published December 3, 2009

4. ***Automated Kernel Extraction****,* N. Eklund, W. Yan, A. Varma, P. Bonissone, filed May 31, 2007, PUB_20090132855, published May 21, 2009.
5. ***System and Method for Meeting Payer Protocols***, D. Belcher, M. Ammer, W. Cheetham, R. Subbu, F. Xue, B. Scholz, P. Bonissone, filed May 15, 2007, PUB_20080288280, published November 20, 2008.
6. ***System And Method For Equipment Remaining Life Estimation,*** K. Goebel, P. Bonissone, W. Yan, N. Eklund, F. Xue, filed February 23, 2007, PUB_20080208487, published August 28, 2008
7. ***System And Method For Equipment Life Estimation***, P. Bonissone, F. Xue, A. Varma, K. Goebel, W. Yan, N. Eklund, filed Dec 7, 2006, PUB_20080140352, published June 12, 2008.
8. ***Method and system of creating health operating envelope for dynamic systems by unsupervised learning of a sequence of discrete event codes,*** W. Yan, A. Varma, P. Bonissone, (20080091715), provisional filing, 2006, filed May 31, 2007, PUB_ 2008091715published April 17, 2008.
9. ***System and method for defining normal operating regions and identifying anomalous behavior of units within a fleet, operating in a complex, dynamic environment,*** P. Bonissone, W. Yan, N. Iyer, K. Goebel, A. Varma, (20080091630), provisional filing, 2006, filed May 31, 2007, , PUB_ 2008091630 published April 17, 2008.
10. ***System and Method for scheduling machines for Inspection,*** M. Nelson, N. Iyer; J. Hershey, C. Seeley, P. Bonissone, F. Goebel, (182617-1), filed February 1, 2006, PUB_20070179747 , published Aug 2, 2007.
11. ***Methods and systems for predictive modeling using a committee of models,*** R. Subbu, P. Bonissone, F. Xue, filed Dec 8, 2005**,** PUB_20070135938, published June 14, 2007.
12. ***Method and system for performing model-based multi-objective asset optimization and decision-making***, (165411), R. Subbu, P. Bonissone, N. Eklund N. Iyer, R Shah, W. Yan, C. Knodle, J. Schmid, filed April 28, 2005
    PUB_20060271210, published Nov. 30, 2006. (EP1717735, CA2544360)
13. ***Method and system for performing multi-objective predictive modeling, monitoring, and update for an asset***, R. Subbu, P. Bonissone, N. Eklund N. Iyer, R Shah, W. Yan, C. Knodle; J. Schmid*,*
    PUB_20060247798, filed April 28, 2005, published November 2, 2006.
    (EP1717736 , CN1866286, CA2545121, AU2006201792)
14. ***Methods, systems, and computer program products for implementing condition monitoring activities***, J. Hershey, K. Goebel, P. Bonissone, N. Iyer, C. Hatch, W. Yan, H. Tomlinson, PUB_20060174164, filed February 1, 2005, published August 3, 2006.
    (EP1686443)
15. ***Systems and methods for initial sampling in multi-objective portfolio analysis****,* S. Bollapragada, P. Bonissone*,* K. Chalermkraivuth, N. Eklund, N. Iyer, R. Subbu, PUB_20050187849, filed February 20, 2004, published Aug 25, 2005
16. ***Systems and methods for multi-objective portfolio analysis using Pareto sorting evolutionary algorithms*****,** R. Subbu, S. Bollapragada, P. Bonissone*,* K. Chalermkraivuth, N. Eklund, N. Iyer, PUB_20050187846, filed February 20, 2004, published Aug 25, 2005
17. ***Systems and methods for multi-objective portfolio analysis using dominance filtering****,* N. Eklund, S. Bollapragada, P. Bonissone*,* K. Chalermkraivuth, N. Iyer, R. Subbu,
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18. ***System and method for using medication and medical condition information in automated insurance underwriting****,* P. Bonissone, K. Aggour, J. Hurley-Tuel, R. Storms,
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1992: *Planning in an uncertain and dynamic environment with weak domain theory,* S. Ayub, CS Dept, [Co-Advisor: D. Spooner], December. 1992
1987: *A Differential Method for Reasoning by Analogy,* G. Porter, ECSE Dept, [Co-Advisor: R. McNaughton], August 1987
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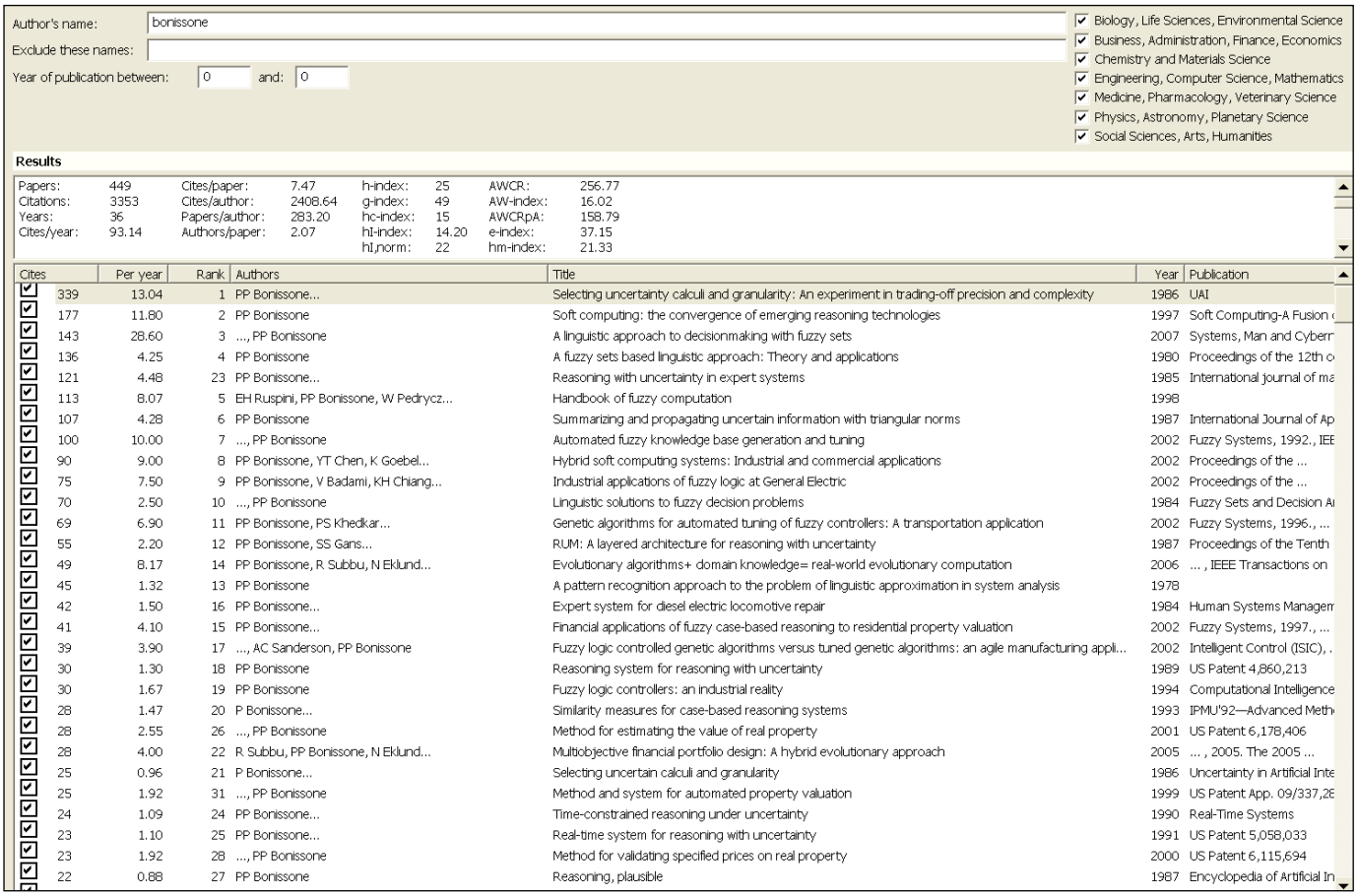
Hirsch's H-Index Calculation (based on Google scholar) = 25 (as of **Feb 23**, 2011)
G-Index Calculation (based on Google scholar) = 49 (as of **Feb 23**, 2011)

Tool to compute H-Index: Harzing's Publish or Perish:
http://www.harzing.com/resources.htm#/pop_hindex.htm



Author's name: bonissone
Exclude these names:
Year of publication between: 0 and: 0

- Biology, Life Sciences, Environmental Science
- Business, Administration, Finance, Economics
- Chemistry and Materials Science
- Engineering, Computer Science, Mathematics
- Medicine, Pharmacology, Veterinary Science
- Physics, Astronomy, Planetary Science
- Social Sciences, Arts, Humanities

Results

Papers:	449	Cites/paper:	7.47	h-index:	25	AWCR:	256.77
Citations:	3353	Cites/author:	2408.64	g-index:	49	AW-index:	16.02
Years:	36	Papers/author:	283.20	hc-index:	15	AWCRpA:	158.79
Cites/year:	93.14	Authors/paper:	2.07	hI-index:	14.20	e-index:	37.15
				hI,norm:	22	hm-index:	21.33

Cites	Per year	Rank	Authors	Title	Year	Publication
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143	28.60	3	..., PP Bonissone	A linguistic approach to decisionmaking with fuzzy sets	2007	Systems, Man and Cyberr
136	4.25	4	PP Bonissone	A fuzzy sets based linguistic approach: Theory and applications	1980	Proceedings of the 12th
121	4.48	23	PP Bonissone...	Reasoning with uncertainty in expert systems	1985	International journal of ma
113	8.07	5	EH Ruspini, PP Bonissone, W Pedrycz...	Handbook of fuzzy computation	1998	
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90	9.00	8	PP Bonissone, YT Chen, K Goebel...	Hybrid soft computing systems: Industrial and commercial applications	2002	Proceedings of the ...
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45	1.32	13	PP Bonissone	A pattern recognition approach to the problem of linguistic approximation in system analysis	1978	
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39	3.90	17	..., AC Sanderson, PP Bonissone	Fuzzy logic controlled genetic algorithms versus tuned genetic algorithms: an agile manufacturing appli...	2002	Intelligent Control (ISIC),
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30	1.67	19	PP Bonissone	Fuzzy logic controllers: an industrial reality	1994	Computational Intelligence
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22	0.88	27	PP Bonissone	Reasoning, plausible	1987	Encyclopedia of Artificial In