

# Brian J. Taylor

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## Summary:

- Experience in the field of machine learning, relational learning and causal inference, and causal knowledge discovery.
- Experience in peer production systems and collaborative sensing.
- Experience in neural network design and analysis.
- Experience with software engineering, specifically verification and validation (V&V).
- Published in several conferences, journals. Published two books.

## Education:

PhD in Computer Science, University of Massachusetts (expected graduation Dec 2011)

MS Computer Science, University of Massachusetts (May 2008)

Thesis: Photobase – A Research Platform to Investigate Peer Production and Collaborative Sensing Systems.

MS Electrical Engineering, West Virginia University (Dec 1999)

Thesis: Regressive Model Approach to the Generation of Test Trajectories.

BS Electrical Engineering, summa cum laude, West Virginia University (May 1997)

BS Computer Engineering, summa cum laude, West Virginia University (May 1997)

## Current Research:

### *Causal Knowledge Discovery*

(December 2007 – Current) I am working with other members of the Knowledge Discovery Laboratory at the University of Massachusetts Amherst to create a system that enables causal knowledge discovery. Our first approach was the identification of quasi-experimental designs (QEDs) from static, observational data. QEDs are traditionally found through manual, time-consuming means. Our automated system is able to find large numbers of possible QEDs and then reduce that number through analysis of dependencies in the data, generating a list of highly likely candidates for good QEDs. Our current work is a more complex system that will identify a larger set of potential experimental designs including QEDs. The software can then automatically apply these designs and build a causal model over the data set through an iterative process.

### *Investigation into Peer Production and Collaboration Sensing Systems (Master Thesis Research)*

(December 2007 – Current) I have developed a small research platform to investigate

peer production and collaborative sensing systems called Photobase. These are systems where people come together to generate or gather content that is then used and shared by the community. Wikipedia is an example. Photobase allows us to experiment while participants use the system so we can evaluate what influences and effects their behavior and levels of participation. The Photobase design and experimental controls enable strong causal inference. For example I have already found that when participants view the collaboration as a competition, they participate less frequently than those who do not. The study also suggests that for any participatory system that includes areas infrequently traveled will either need to rely on a very large and carefully selected participant list or use coordination to guarantee coverage.

### *Development of Learning Algorithms for Relational Models*

(September 2005 – Current) I am researching relational learning techniques in the Knowledge Discovery Laboratory at the University of Massachusetts Amherst. I have been studying techniques to detect fraudulent behavior among brokers who are licensed by the National Association of Securities Dealers. I investigated different data normalizations and representations to preprocess the data prior to our applying of a learning algorithm to it. I have also been investigating biases such as relational autocorrelation and degree dependence within datasets and how these biases affect the performance and accuracy of models that we learn. I have developed new methods for measuring these biases, methods for generating data with these biases, and implemented techniques to correct for these biases.

### **Previous Research:**

#### *Verification & Validation of Neural Networks*

(December 1999 – July 2006) As a member of the Institute for Scientific Research, I was a part of a research team on the *Intelligent Flight Control Systems* Project funded by NASA Dryden Flight Research Center that developed, implemented, and flight qualified an intelligent flight control systems onboard an experimental F-15 aircraft. I led the analysis and verification of the neural networks and I assisted in refining their design.

I successfully bid on and won the *Independent Verification and Validation of Neural Networks* project between ISR and the NASA IV&V facility, which ensures software quality for NASA developed software. I led the project as Principal Investigator, and was responsible for development of a methodology that can supplement the IEEE standard for verification and validation (IEEE 1012-1998). I supervised a team composed of researchers with many different backgrounds and degrees, including team members with PhDs. In addition to team and project management activities, I investigated novel techniques into neural network rule extraction to translate the inner knowledge of a self-organizing neural network into a formal set of rules that can then be used for validation, testing, design refinement, and hazard mitigation. I also successfully bid on and won a Phase I STTR from the NASA Ames Research Center for the NNRules project, follow-on to the rule extraction research.

## *Regressive Model Approach to the Generation of Test Trajectories* (Master Thesis Research)

(August 1998 – December 1999) My thesis, conducted independently under the supervision of Dr. Bojan Cukic, was in the field of software engineering. The algorithm I designed builds a regression model that allows for the automated generation of statistically related test data from existing continuous data sequences (called trajectories). Examples of uses of this data include reliability assessment, sensitivity analysis, and brute force testing.

### **Publications:**

#### Thesis

Taylor, Brian J. *Photobase – A Research platform to Investigate Peer Production and Collaborative Sensing Systems*. Computer Science Department, University of Massachusetts, Amherst, MA, May 2008.

Taylor, Brian J. *Regressive Model Approach to the Generation of Test Trajectories*. Department of Computer Science and Electrical Engineering, West Virginia University, WV, December 1999.

#### Books

Pullum, Laura L., Brian J. Taylor, Marjorie A. Darrah. *Guidance for the Verification and Validation of Neural Networks*. Wiley – IEEE Computer Society. March 2007.

Taylor, Brian J. Editor. *Methods and Procedures for the Verification and Validation of Artificial Neural Networks*. Springer. 2005.

#### Journal Articles

Darrah, Marjorie, Taylor, B. A Rule Extraction Approach used for Verification of a Safety Critical Application. Submitted Aug 2010 to the IEEE Transactions on Neural Networks. Undergoing review.

Pullum, Laura L., Marjorie A. Darrah, and Brian J. Taylor. Independent Verification and Validation of Neural Networks – Developing Practitioner Assistance. *Software Tech Newsletter* 7(2), pp. 11-14. 2004.

Cukic, Bojan, B. J. Taylor, H. Singh, Automated Generation of Test Trajectories for Embedded Flight Control Systems, *International Journal of Software Engineering and Knowledge Engineering*, 12(2), pp. 175-200. 2002.

Brown, Kolin S., B. J. Taylor, L. A. Hornak, and T. W. Weidman, Characterization of Poly(phenylsilsesquioxane) Thin-film Planar Optical Waveguides, *IEEE Photonic Technology Letters*, vol.9(6), June 1997, pp. 791-793.

## Conference Papers

Taylor, Brian, Rossi, R., Corner, M., Jensen, D. Building Better Participatory Sensing Systems. In preparation for submission to MobiSys 2011.

Oktaç, Hüseyin, B. Taylor, and D. Jensen. Causal Discovery in Social Media Using Quasi-Experimental Designs. In the Proceedings of the ACM/SIGKDD Workshop on Social Media Analytics, Washington D.C. 2010.

Maier, Marc, B. Taylor, H. Oktaç, and D. Jensen. Learning Causal Models of Relational Domains. In the Proceedings of the Twenty-Fourth AAAI Conference on Artificial Intelligence. 2010.

Jensen, David, A. Fast, B. Taylor, M. Maier. Automatic Identification of Quasi-Experimental Designs for Discovering Causal Knowledge. Submitted to the 14th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, February 29, 2008.

Jensen, David, A. Fast, B. Taylor, M. Maier, and M. Rattigan. Automatic Identification of Quasi-Experimental Designs for Scientific Discovery. AAAI Fall Symposium on Automated Scientific Discovery. 2008.

Fast, Andrew, L. Friedland, M. Maier, B. Taylor, D. Jensen, H. Goldberg and J. Komoroske. Relational data pre-processing techniques for improved securities fraud detection. In The Proceedings of the 13th International Conference on Knowledge Discovery and Data Mining, pp. 941-949. (Also appears as University of Massachusetts Amherst, Technical Report 07-20.) 2007.

Taylor, Brian J., Marjorie Darrah. Rule Extraction as a Formal Method for the Verification and Validation of Neural Networks. International Joint Conference on Neural Networks (IJCNN'05). Montreal, Quebec, Canada, July 31 – August 4, 2005.

Darrah, Marjorie, Brian Taylor and Michael Webb. A Geometric Rule Extraction Approach used for Verification and Validation of a Safety Critical Application. 18th Annual Florida Artificial Intelligence Research Society Conference, Clear Water Beach, FL, May 16-18, 2005.

Taylor, Brian J., Marjorie Darrah, Spiro Skias. Weaving it All Together - A Methodology for the Verification and Validation of Adaptive Neural Networks. NIPS-2004 Workshop on Verification, Validation, and Testing of Learning Systems. Whistler, British Columbia, Canada, December 2004.

Darrah, Marjorie, Brian Taylor and Spiro Skias. Rule Extraction From Dynamic Cell Structure Neural Network Used in a Safety Critical Application. In Proceeding of Florida Artificial Intelligence Research Society Conference, Miami FL, May 17-19, 2004.

Taylor, Brian J., M. A. Darrah, C. Moats. Verification and Validation of Neural Networks: A Sampling of Research in Progress, SPIE's 17th Annual International Symposium on Aerospace/Defense Sensing, Simulation, and Controls (AeroSense 2003), Orlando, FL, April 21-25, 2003.

Taylor, Brian, B. Cukic, Evaluation of Regressive Methods for Automated Generation of

Test Trajectories, Proceedings of the 11th International Symposium on Software Reliability Engineering ISSRE 2000, San Jose CA, October 8-11, 2000, pp. 97-109.

Taylor, Brian, B. Cukic, Regressive Model Approach to the Generation of Test Trajectories, Proceedings of the 3rd IEEE Symposium on Application-Specific Systems and Software Engineering Technology ASSET 2000, Richardson, Texas, March 24-25 2000, pp. 49-56.

Brown, Kolin S., B. J. Taylor, J. M. Dawson, and L. A. Hornak, Polymer Waveguide Cointegration with Microelectromechanical Systems (MEMS) for Integrated Optical Metrology, SPIE Photonics West Symposium, Miniaturized Systems with Micro-Optics and Micromechanics III, San Diego, CA, January 1998, pp. 112-122.

Brown, Kolin S., B. J. Taylor, L. A. Hornak, and T. W. Weidman, Characterization of Poly(phenylsilsesquioxane) (PPSQ) for Planar Integrated Optical Waveguide Applications, SPIE Photonics West Symposium, Optical Interconnects and Packaging IV, San Jose, CA, February 1997, pp. 163-169.

Hornak, Larry A., K. S. Brown, B. J. Taylor, and J. C. Barr, Polymer Guided-Wave Integrated Optics: An Enabling Technology for Micro-Opto-Electro-Mechanical Systems, SPIE Photonics West Symposium, Micro-Optics and Micromechanics II, San Jose, CA, February 1997, pp. 124-135.

## Tech Reports

Taylor, Brian J., Marjorie Darrah, Laura Pullum, James T. Smith, Leon Luxemburg, Spiro Skias, and Bojan Cukic. Methods and Procedures for the Independent Verification and Validation of Neural Networks. Technical Report prepared by Institute for Scientific Research, Inc. for NASA Independent Verification and Validation Facility under grant NAG5-12069. 2004.

Taylor, Brian J., Marjorie Darrah, James T. Smith, Spiro Skias. Introduction to the Development of Methodologies for the Independent Verification and Validation of Neural Networks. Technical Report prepared by Institute for Scientific Research, Inc. for NASA Independent Verification and Validation Facility under grant NAG5-12069. 2003.

Taylor, Brian J., Marjorie Darrah, Pat Adams, Brian Stolarik, James T. Smith, Spiro Skias. Toward Reliable Neural Network Software for the Development of Methodologies for the Independent Verification and Validation of Neural Networks. Technical Report prepared by Institute for Scientific Research, Inc. for NASA Independent Verification and Validation Facility under grant NAG5-12069. 2002

## **Employment:**

(June 2010 – Current) Research Scientist. I am employed with the Institute for Defense Analysis on a DARPA initiative to study how we can improve the automated analysis of data collection system to gain new insights and otherwise unknown knowledge.

(Jan 2010 – May 2010) Graduate Researcher. I worked with WorkForce Logic, Inc. as a temporary employee for Yahoo! Research in order to conduct research into the causal modeling of the Yahoo! Answers database.

(September 2005 – Current) *Graduate Researcher*, I am a member of the Knowledge Discovery Laboratory in the Computer Science Department at the University of Massachusetts Amherst.

(December 1999 – July 2006) *Principal Member Research Staff*. I was employed by The Institute for Scientific Research (ISR) (formerly Institute for Software Research) located in Fairmont, WV.

(August 1998 - December 1999) *Graduate Researcher*. I worked under Dr. Bojan Cukic at the West Virginia University on research aimed towards my Masters Thesis.

(August 1997 - May 1998) *Graduate Teaching Assistant* at West Virginia University. I was an instructor for Electrical Engineering 57, Digital Electronics Lab and Computer Engineering 72, Digital Design Lab. My responsibilities included the preparation and design of weekly lab assignments and administering my own developed tests.

(1996, 95 Summer) *Undergraduate Research Assistant at West Virginia University* I was a member of the Microelectronics System Research Center (MSRC) as a research assistant for Dr. Larry A. Hornak where I worked in the area of MEMS design and analysis.

### **Undergraduate Honors, Awards, and Activities:**

- EG & G Byrd Scholarship (1996)
- National Science Scholarship (1992 – 1996)
- WVU Presidential Scholarship (1992 – 1996)
- Scrivner Scholarship (1992, 1993)
- Fineman Scholarship (1992)
- Pi Kappa Phi
- Eta Kappa Nu, Electrical Engineering Honorary, (President 1995 - 1996)
- WVU Honors Program
- Golden Key Honor Society
- Helvetia, Sophomore Honorary
- Graduated Summa Cum Laude

### **Graduate Honors, Awards and Activities:**

- CSEE Department Scholarship (1997 – 1998)
- Outstanding Evaluation as Teaching Assistant for EE 57 Lab (Fall 1997, Spring 1998)
- Outstanding Evaluation as Teaching Assistant for CpE 72 Lab (Spring 1998)
- West Virginia University/NASA scholarship and research assistantship (1998 – 1999)
- SERC Showcase Fall 1998 Poster Presentation: Taylor B, Trajkovski G, Cukic B. Reliability Prediction of Intelligent Fault-Tolerant Flight-Control Systems. SERC Showcase Fall 1998, WVU, Morgantown, WV, USA, 1998.
- ISSRE 1999 Student Travel Grant, presented 6-page poster: Taylor, B. Regressive Model Approach to the Generation of Test Trajectories. ISSRE99 10<sup>th</sup> International Symposium on Software Reliability Engineering, Boca Raton, Florida, November 1- 4, 1999.
- NSF Graduate Research Fellowship Honorable Mention, 2005.

### **Professional Honors and Activities:**

- Principal Investigator on the IVVNN project (2002 – 2005)

- Youngest Principal Member of Research at Institute for Scientific Research, Inc. (2004)
- Conference reviewer for the IEEE Aero 2006
- Conference reviewer for the International Joint Conference on Neural Networks (2007)
- IEEE Member, 11 years (Computer Society, Computational Intelligence Society, Systems, Man, and Cybernetics Society)
- Member of the International Society for Optical Engineering (SPIE)
- Member of the American Institute of Aeronautics and Astronautics