

Michael Scott Balch, PhD

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Contact Information:

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Summary:

Research-practitioner with 12 years of experience, specializing in aerospace engineering, uncertainty quantification, statistical inference, and model validation.

Education:

Ph.D. Aerospace Engineering Virginia Polytechnic Institute and State University
December 2010 (Virginia Tech)

M.S. Aerospace Engineering Virginia Polytechnic Institute and State University
May 2008 (Virginia Tech)

B.S. Aerospace Engineering Virginia Polytechnic Institute and State University
May 2006 (Virginia Tech)

Employment:

Technical Lead June 2014 - Present
Alexandria Validation Consulting, LLC

Identified root cause of "probability dilution" in satellite conjunction analysis. Developed proprietary algorithms for computing collision risk in satellite conjunction analysis and for validating financial models.

Technical Staff April 2013 - April 2014
Arctan, Inc.

Project Manager: Charles Morefield
Company Owner: Michael Morefield

Developed linearly scalable algorithm for computing correlations between large numbers of time series. This was applied to stock market data.

Research Engineer August 2012 - April 2013
*AFRL/RQHF at Wright-Patterson Air Force Base contracting through Universal
Technology Corporation (UTC)*

Project Manager: Benjamin P. Smarslok
UTC Managers: Roger Rucker and Lanny Jines

Developed statistical approach for assessing plausibility of different explanations for bias in legacy hypersonic wind tunnel data, allowing for free parameters in the proposed models.

Post-Doctoral Researcher
Applied Biomathematics

January 2011 - June 2012

Project Manager: Scott Ferson
Company Owner: Lev Ginzburg

Formulated the theory of confidence structures to support applications in medical health risk assessment.

Graduate Research Assistant

August 2006 - December 2010

Virginia Tech, Department of Aerospace and Ocean Engineering

Project Manager: Robert Tolson
Doctoral Adviser: Robert Walters

Developed and applied methods appropriate to the quantification of parameter uncertainty in Mars atmosphere models. This included work in black-box response surface methodology (non-intrusive polynomial chaos) and the adoption of Dempster-Shafer theory to represent a combination of probabilistic and non-probabilistic uncertainty sources. I spent May 2008 through December 2010 embedded at NASA Langley through the National Institute of Aerospace.

Publications:

Balch, M.S. (2019). "New two-sided confidence intervals for binomial inference derived using Walley's imprecise posterior likelihood as a test statistic." *Manuscript under peer review*.

Balch, M.S., Ryan, M., and Ferson, S. (2019). "Satellite conjunction analysis and the false confidence theorem." *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*. 475(2227).

Balch, M.S. (2016). "A corrector for probability dilution in satellite conjunction analysis." *at 18th AIAA Non-Deterministic Approaches Conference*. San Diego, CA.

Balch, M.S. and Smarslok, B. (2014). "A pre-validation study on supersonic wind tunnel data collected from legacy aerothermal experiments." *at 16th AIAA Non-Deterministic Approaches Conference*. National Harbor, MD.

Ferson, S., Balch, M., and O'Rawe, J. (2014). "Computing with confidence: Imprecise posteriors and predictive distributions." in *Vulnerability, Uncertainty, and Risk: Quantification, Mitigation, and Management*.

Ferson, S., Balch, M., Sentz, K., and Siegrist, J. (2013). "Computing with confidence." *at 8th International Symposium on Imprecise Probability: Theory and Applications*. Compiègne, France.

Balch, M.S. (2012). "Mathematical foundations for a theory of confidence structures." *International Journal of Approximate Reasoning*. 53(7).

Roy, C.J., and Balch, M.S. (2012). "A holistic approach to uncertainty quantification with application to supersonic nozzle thrust." *International Journal for Uncertainty Quantification*. 2(4).

Balch, M.S. (2010). *Methods for rigorous uncertainty quantification with application to a Mars atmosphere model*. Doctoral dissertation, Virginia Tech. Blacksburg, VA.

Hosder, S., Walters, R.W., and Balch, M. (2010). "Point-collocation nonintrusive polynomial chaos method for stochastic computational fluid dynamics." *AIAA Journal*. 48(12).

Balch, M., Hosder, S., and Walters, R. (2008). "Modeling and propagation of physical parameter uncertainty in a Mars atmosphere model." *at 46th AIAA Aerospace Sciences Meeting and Exhibit*. Reno, NV.

Hosder, S., Walters, R.W., and Balch, M. (2008). "Efficient uncertainty quantification applied to the aeroelastic analysis of a transonic wing." *at 46th AIAA Aerospace Sciences Meeting and Exhibit*. Reno, NV.

Hosder, S., Walters, R.W., and Balch, M. (2007). "Efficient sampling for non-intrusive polynomial chaos applications with multiple uncertain input variables." *at 9th AIAA Non-Deterministic Approaches Conference*. Honolulu, HI.

Computing Languages and Environments:

Matlab	10 years	Fortran 95	2 years
R	7 years	LaTeX	12 years
Linux/Unix	4 years	Microsoft Office	16 years
C++	5 years		

Awards:

Winner of 2006 AIAA Undergraduate Team Space Design Competition
Peter and Phyllis Pruden Scholarship (2004-2005)

Memberships:

Tau Beta Pi, Engineering Professional Fraternity
Sigma Gamma Tau, Aerospace Engineering Honor Society
American Institute of Aeronautics and Astronautics (AIAA)