

Michael Scott Balch, PhD

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Contact Information:

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Summary:

Researcher with 14 years of experience, specializing in aerodynamics, orbital mechanics, uncertainty quantification, statistical inference, and model validation.

Education:

Ph.D. Aerospace Engineering December 2010	Virginia Polytechnic Institute and State University (Virginia Tech)
M.S. Aerospace Engineering May 2008	Virginia Polytechnic Institute and State University (Virginia Tech)
B.S. Aerospace Engineering May 2006	Virginia Polytechnic Institute and State University (Virginia Tech)

Employment:

Technical Lead June 2014 - Present
Alexandria Validation Consulting, LLC

Conduct basic research and develop proprietary software in statistics and uncertainty quantification applications. Identified root cause of "probability dilution" in satellite conjunction analysis.

Technical Staff April 2013 - April 2014
Arctan, Inc.

Developed linearly scalable algorithm for computing correlations between large numbers of time series.

Research Engineer August 2012 - April 2013
Universal Technology Corporation (UTC)

Embedded in AFRL/RQHF at Wright-Patterson AFB. Developed and applied novel statistical approach for assessing the plausibility of different physical explanations for bias in legacy hypersonic wind tunnel data.

Post-Doctoral Researcher January 2011 - June 2012
Applied Biomathematics

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

Embedded at NASA Langley 2008-2010. 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.

Publications:

Oberkampf, W.L. and Balch, M.S. (2020) "Closure on the discussion of 'Models, uncertainty, and the Sandia V&V challenge problem' by G. A. Hazelrigg and G. A. Klutke" *ASME Journal of Verification, Validation and Uncertainty Quantification*. 5(3).

Balch, M.S. (2020). "New two-sided confidence intervals for binomial inference derived using Walley's imprecise posterior likelihood as a test statistic." *International Journal of Approximate Reasoning*. vol. 123. p. 77-98.

Balch, M.S., Martin, R., 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	9 years	LaTeX	14 years
Linux/Unix	4 years	Microsoft Office	18 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), Lifetime Member