Paul W. Talbot

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PROFESSIONAL EXPERIENCE

Idaho National Laboratory, Idaho Falls, ID

Integrated Energy Systems (IES) 2017 - Present

- *PI and lead developer, HERON (github.com/idaholab/HERON)*
  Led a small team of developers in implementing HERON, a Python-based object-oriented plugin of RAVEN for stochastic techno-economic optimization of grid-energy systems. Planned, designed, and deployed software under continuous-deployment version control and software quality assurance. Provided training and deployed plugin for analyses of novel integrated energy system technologies in several markets, with partner industries, other national laboratories, and universities.
- *2021 LDRD awarded: Signal processing for cybersecurity*
  Managed a 3-year $1.5M project including lab and university researchers to explore using high/low order correlation for false data injection detection in physical process signals, including toolset software development and demonstration on experimental systems.
- *Stochastic gradient descent optimization R&D*
  Extended RAVEN software to perform system optimization using stochastic gradient descent algorithms, including forward and central differencing as well as Simultaneous Perturbation Stochastic Approximation (SPSA) gradient descent. Extended existing algorithms to solve stochastic system optimization problems.
- *Point of contact for multiple awarded university-led (NEUP) proposals*

Uncertainty Quantification 2014 - 2017

- *Sparse grid collocation for generalized polynomial chaos*
  As part of doctorate work, extended RAVEN sampling and reduced-order model methods to include sparse grid collocation sampling for multidimensional polynomial surrogate models. Demonstrated strengths and weaknesses of algorithm on several analytic as well as real-world problems.
- *High-dimension model reduction*
  Implemented HDMR to accelerate polynomial fitting using sparse grid collocation, including both static and adaptive sampling strategies.
- *Agile development, maintenance, refactoring, quality assurance*
- *Continuous integration deployment*
- *Senior developer, RAVEN (github.com/idaholab/raven)*
  Trained new users and developers in RAVEN as well as orchestrated signifcant new development and reworks of several systems in RAVEN as needs adjusted, managing performance in both memory and speed. Responded frequently to user queries, offering guidance or implementing code changes. Reviewed proposed code changes for software quality assurance, iterating with developers to improve code contributions.
- *Python, LaTeX, C++, Conda, Bash*

Internships

- 2012 INL, MOOSE Deployment packages and regression testing
- 2011 LANL, Discrete maximum principle for iMC equations
- 2010 INL, MARMOT Frenkel pair distribution R&D
- 2009 AREVA, BLEU effective enrichment research
- 2008 AREVA, CASMO4 and MICROBURN-B2, benchmarking

EDUCATION

Doctor of Philosophy, Nuclear Engineering
University of New Mexico, Albuquerque, New Mexico, GPA 4.08 December 2016
Thesis - Advanced Stochastic Collocation Methods for Polynomial Chaos in RAVEN

- Researched, implemented multidimensional sparse grid sampling techniques
- Distribution-specific polynomial fitting for uncertain variables
- Vast statistical convergence improvement demonstrated for continuous responses
- Development in Object-Oriented Python (RAVEN framework, github.com/idaholab/raven)
- Software quality assurance, version control (Git)
- Intership, Idaho National Laboratory

Master of Science, Nuclear Engineering
Oregon State University, Corvallis, Oregon, GPA 3.75 March 2013
Thesis - Extending the Discrete Maximum Principle for the IMC Equations

- Research, implemented theoretical maximum for implicit Monte Carlo
- Improved solve strategy for nonlinear photon transport
- Intership, Los Alamos National Laboratory

Bachelor of Science, Physics
BYU-Idaho, Rexburg, Idaho, GPA 3.84 April 2010

- Investigate down-blended vs fresh UO2 performance in BWR assembly
- CASMO4, MICROBURN-B2, ALLADIN benchmarking
- Power shapes, pin peaking, design limits
- Intership, AREVA NP in Richland, WA

COMPUTING SKILLS

Extensive use of Python (Conda, Pandas, Xarray, SKLearn, Statsmodels, OOP/Functional), Git, Bash
Experience with C++, MatLab, Visual Basic

SAMPLE PUBLICATIONS

- P. W. Talbot, D. McDowell, et al, "Evaluation of Hybrid FPOG Applications in Regulated and Deregulated Markets using HERON", INL report INL/EXT-20-60968, 2020
- P. W. Talbot, C. Rabiti, et al, "Correlated Synthetic Time Series Generation using Fourier and ARMA signal processing," Int. J. Energy Res. 2020; 1-12. https://doi.org/10.1002/er.5115
- A. Epiney, C. Rabiti, P. Talbot, et al, "Economic analysis of a nuclear hybrid energy system in a stochastic environment including wind turbines in an electricity grid", Applied Energy 2020; 260, 114227
- P. W. Talbot, et al, "Analysis of Differential Financial Impacts on LWR Load-Following Operations", INL report INL/EXT-19-55614, 2019
- K. Frick, P. Talbot, et al, "Evaluation of Hydrogen Production Feasibility for a Light Water Reactor in the Midwest", INL report INL/EXT-19-55395, 2019
- A. Epiney, C. Rabiti, P. Talbot, et al, "Case Study: Nuclear-Renewable-Water Integration in Arizona", INL report INL/EXT-18-51369, 2018
- C. Rabiti, A. Epiney, P. W. Talbot, et al, "Status Report on Modeling and Simulation Capabilities for Nuclear-Renewable Hybrid Energy Systems", INL Report INL/EXT-17-43441, 2017

- P. W. Talbot, "Advanced Stochastic Collocation Methods for Polynomial Chaos in RAVEN,", Ph. D. Dissertation, Department of Nuclear Engineering, University of New Mexico, December 2016
- P. W. Talbot, C. Wang, et al, "Multistep Input Reduction for High Dimensional Uncertainty Quantification in RAVEN Code," ANS PHYSOR 2016
- P. W. Talbot, K. Gamble, et al, "Time-Dependent Sensitivity Analysis of OECD Benchmark using BISON and RAVEN," 2016 ANS winter conference transactions
- P. W. Talbot, A. K. Prinja, C. Rabiti, "Adaptive Sparse-Grid Stochastic Collocation Uncertainty Quantification Convergence for Multigroup Diffusion," 2016 ANS annual conference transactions
- C. Wang, P. W. Talbot, et al, "An efficient Sampling-Based Method for Sensitivity and Uncertainty Analysis through RAVEN," 2016 ANS annual conference transactions
- P. W. Talbot, A. K. Prinja, C. Rabiti, "High Density Model Reduction Uncertainty Quantification for Multigroup Diffusion Neutronics," 2015 ANS M&C topical conference transactions
- P. W. Talbot, A. K. Prinja, "Sparse-Grid Stochastic Collocation Uncertainty Quantification Convergence for Multigroup Diffusion," 2014 ANS winter conference transactions
- P. W. Talbot, "Extending the Discrete Maximum Principle for the IMC equations," Oregon State University masters thesis, September 2012
- P. W. Talbot, A. B. Wollaber, T. Palmer, "Implementing a Discrete Maximum Principle for the IMC Equations," 2012 ANS general conference transactions, M & C division

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- OSTI: `https://www.osti.gov/search/orcid:0000000296729044`
- Publons (reviews): `https://publons.com/researcher/3839497/paul-talbot/`

MEMBERSHIPS

- Reviewer:
  - *Applied Energy*
  - *Energies*
  - *Mathematics*
  - *Nuclear Science and Engineering*
  - *Nuclear Technology*
- Conference reviewer: ANS, ANS M&C
- Technical Program Committee, ANS M&C 2019
- Member, American Nuclear Society

References available on request.