Jesper Toft Kristensen, PhD

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PROFESSIONAL EXPERIENCE

General Electric Company (GE) - Global Research 4/2018-present
Lead R&D Engineer - Probabilistics Team
Managers: Dr. Liping Wang and Dr. Darren Hallman

Highlighted projects

- Project Lead on the "Advanced Design Tools" program
  - $1 million project leading 5 research engineers
  - 90% savings in optimization for GE Power
  - $45,000 savings per test for GE Aviation
  - $5,000/hr savings per turbine test for GE Power
  - 50% faster Gaussian Process for the lab
  - Develop state-of-the-art probabilistics technologies
  - Deliver fast robust solutions to challenging industry applications
  - Provide training and mentoring in tools and methods
  - Multiple scientific conference and internal technical papers
- Predictive analytics for steam turbines (Docker deployment on Predix)
  - Enable Digital Twin of turbine

General Electric Company (GE) - Global Research 9/2015-4/2018
R&D Engineer –Probabilistics Team
Managers: Dr. Liping Wang and Dr. Darren Hallman

Highlighted projects

- Develop analytics for pit corrosion for engines (GE GRC & GE Aviation)
  - Save millions on scrapped parts
- Intelligent DACE (GRC)
  - Project lead on $25,000 funding awarded from GE corporate
- Piston surrogate modeling and optimization (GE Power)
  - Project presentation for GE Power's Vice President
- Oil pump optimization (GE Oil & Gas)

- Accurate prediction of engine failure (GRC)
- Compressor optimization (GE Oil & Gas)
- Develop algorithms for GE Digital Twins (GRC)
- Reliability models of wind turbine gearbox failures in customer parks (GE Renewables)
- Developing diagnostic and prognostic tools for the Lab's central probabilistic method (Bayesian Hybrid Modeling, a GP based tool) (GRC)

Training

Deep Learning Specialization, deeplearning.ai & Coursera 8/2018
Project Management, GE 10/2016
GE Six Sigma Certified (DMAIC & DFSS) 5/2016

Cornell University, New York 2/2012-8/2015
Research Assistant (Mechanical and Aerospace Engineering)
sponsored by the US Department of Energy's Office of Science.
Supervisor: Prof. Nicholas Zabaras

Projects

- Computational materials science: We investigated the effects of uncertainties in pair correlation functions (from density functional theory) on quantities of interest from alloys. We studied, in particular, the effect on the phase transition temperature of SiGe. This is essential in understanding the uncertainties of predicted materials metrics. A publication is in review from this work.
- Computational materials science: We investigated the use of Bayesian thinking and information theoretic methodologies for global optimization of materials properties. We wanted to understand how the input design should be chosen in a given computer experiment where we want to compute a phase transition. I used the Conte and Rice supercomputers at Purdue University to run the experiments. A publication is in review in a special issue of the Journal of Computational Physics from this work.
- Computational materials science: Using the Olympus supercomputer at Pacific Northwest National Lab (PNNL) I developed a method for quantifying uncertainties in alloy properties. But more importantly, I found how to propagate the uncertainties to quantities of interest such as a phase transition or a ground state line. I did this using a Bayesian formalism and by coupling it with a reversible jump Markov Chain Mote

Carlo (RJMCMC) algorithm. I believe I was the first to do this. A paper was published based on this work.
- Computational materials science: Using the Hopper supercomputer I generated a data set of nanowires and computed their thermal conductivities. I then developed a novel cluster expansion technique to aid the fitting process of this low-dimensional structure. A publication was published from this work.

Cornell University 8/2010-4/2014
MS student
Project

- Computational materials science: Using the Olympus supercomputer at the Pacific Northwest National Laboratory (PNNL) I compiled and modified the C++ ATAT software for binary alloy phase diagram computation using cluster expansions. I replaced the built-in standard MCMC library with my own adaptive sequential Monte Carlo (ASMC) approach and showed how the results were improved when compared to experiments. For this project I used VASP as well to obtain energies of alloy structures. A publication was published from this work.
- Computational materials science: We use the HiPerGator supercomputer at the University of Florida to characterize 2D sheets of molybdenum and tungsten (Mo,W) with sulfur anions. We are obtaining the ground states of the system along with phase transitions and characterizations of the band gap using state-of-the-art band gap computations. A publication is in preparation.

Cornell University 8/2010-7/2011
M.Eng. student
Thesis project

- Computational quantum optics: I studied biexciton formation in PdSe nanorods. I found that stable biexcitons can form. I wrote a C++ program to compute and print the energies of biexciton modes. This is important for fundamental understanding of solar cell behavior (where electron-hole pairs, called excitons, are formed---a biexciton is the bonding of two excitons).

Technical University of Denmark (DTU), Denmark 9/2007-7/2010
B.Sc. student

Projects

- Computational/Theoretic microfluidics: We studied the behavior of ionic conduction in nanochannels as well as the zeta potential on the conduction channel wall. We found a previously unknown behavior of the current conductivity by generalizing relevant equations and employing high-accuracy programming methods. A publication came out of this work as well as a filing for a patent on a CO_2 sensor. This was my B.Sc. thesis project.
- Computational quantum optics: We successfully implemented a model for quantum dot lasers and their turn-on dynamics based on a publication. We studied this as a function of various parameters in the model.
- Optics: We investigated fiber splicing and the details of what happened to the splicing junction between hollow-core and single-mode fibers. This was relevant to compression of laser pulses and was essential to the development of a new femtosecond laser at DTU. We identified early warning signs of the splicing which could lead to failure to maintain the polarization of the photons. A paper was published based on this project.

EDUCATION

Cornell University, New York 8/2011-5/2015
PhD student/candidate in Applied Physics.
Thesis: "Uncertainty Quantification with Surrogate Models in Alloy Modeling"
Advisor: Prof. Nicholas John Zabaras (GPA: 3.98/4.00)

Cornell University, New York 8/2011-4/2014
Master of Science in Applied Physics
Advisor: Prof. Nicholas Zabaras (GPA: 3.98/4.00)

Cornell University, New York 8/2010-8/2011
Master of Engineering in Engineering Physics
Department of Applied and Engineering Physics
MEng-thesis supervisor: Prof. Frank Wise (GPA: 4.0/4.0 (award))

Technical University of Denmark 9/2007-6/2010
Bachelor of Science in Engineering in Physics and Nanotechnology.
BSc-thesis: "Theory of electrokinetic effects in nanofluidic channels"
supervisor: Director Prof. Henrik Bruus, DTU Physics (GPA: 11.57/12.00)

TEACHING EXPERIENCE

Cornell University

Position: Tutor/TA in the LSC Physics Help Center. 9/2014-8/2015

- Held office hours (twice a week, 3 hours per session)
- Helped students learn to solve physics problems with at-the-board walkthroughs

Position: Tutor in Office of Academic Diversity Initiatives (OADI) 9/2014-8/2015

- 1-on-1 with students
- Met as often as needed, but typically bi-weekly for 1 hour each session
- Discussed prelim, homework, and general questions about the material

Position: Guest lecturer in PHYS 1112 assistance course. 2/2015

- Provided a lecture on Newton's laws

Position: Guest lecturer in MAE 611. 9/2013

- Gave a lecture on mathematics in mechanical engineering including change of basis, eigen-decomposition, matrix outer products, etc.

Position: Teaching Assistant AEP 1100 9/2011-12/2011

- Theoretical coverage on blackboard followed by 1 hour of physics experiments (focus was on laser demonstrations, taking 3D photos, optical tweezers, etc.)

Technical University of Denmark

Position: Teaching Assistant in basic chemistry. 9/2008-12/2008

- Twice a week held a 1-hour session helping students with engineering chemistry

Position: Teaching Assistant in "Introduction to Physics and Nanotechnology" 1/2010

- Twice a week held a 1-hour session helping students transition into physics and nanotechnology (the most demanding major at TU Denmark)

PUBLICATIONS

19. Ling, Y., Ryan, K., Asher, I., Kristensen, J., Ghosh, S., Wang, L. (2018), "Efficient Robust Design Optimization using Gaussian Process and Intelligent Sampling."
2018 Multidisciplinary Analysis and Optimization Conference

18. Kristensen, J., Asher, I., Wang, L. (2018), "Polynomial Representation of the Gaussian Process."

ASME IDETC/CIE (Paper ID: IDETC2016-59266)

17. Ryan, K., Kristensen, J., Ling, Y., Ghosh, S., Asher, I., Wang, L. (2018), "A Gaussian Process Modeling Approach for Fast Robust Design with Uncertain Inputs."
ASME IGTI, 2018 (paper ID: GT2018-77007)

16. Ghosh, S., Kristensen, J., Asher, I., Ling, Y., Ryan, K., Wang, L. (2017), "Bayesian multi-source modeling with legacy data."
GE Technical report 2017-11-30-63223

15. Ghosh, S., Kristensen, J., Asher, I., Ling, Y., Ryan, K., Wang, L. (2018), "An intelligent sampling framework for multi-objective optimization in high dimensional design space."
2018 AIAA SciTech Conference Paper

14. Ryan, K., Kristensen, J., Ling, Y., Ghosh, S., Asher, I., Wang, L. (2017), "A Gaussian process modeling approach for fast robust design with uncertain inputs."
GE Technical report 2017-10-20-75873

13. Kristensen, J., Pandita, P., Wang, L. (2017), "Increasing the efficiency and predictability of Bayesian Hybrid Modeling (BHM) with Adaptive Sequential Monte Carlo (ASMC)."
GE Technical report 2017-09-18-41256

12. Kristensen, J., Wang, L. (2017), "Portable Bayesian Hybrid Modeling (BHM)."
GE Technical report 2017-06-20-66225

11. Kristensen, J., Ryan, K., Wang, L. (2017), "Documentation of the GE Piston Graphical User Interface and Transient Calibration of Large Data Sets."
GE Technical report 2017-04-24-38487

10. Kristensen, J., Asher, I., Ling, Y., Ryan, K., Subramaniyan, A., Wang, L. (2017), "Predictive Analytics with and advanced Bayesian modeling framework."
MODSIM World 2017

9. Kristensen, J., Kumar, N., Wang, L., and Monteriso, R. (2016), "Modern Probabilistic Methods for Pump Predictability and Optimization at the System and Component Levels."
GE Technical report 2016-02-16-59066

8. Kristensen, J., Ling, Y., and Asher, I. (2016), "Expected-Improvement-Based Methods for Adaptive Sampling in Multi-Objective Optimization Problems."
ASME IDETC/CIE (Paper ID: IDETC2016-59266)

7. Kristensen, J., Bilionis, I., & Zabaras, N. (2016), "Adaptive Simulation Selection for the Discovery of the Ground State Line of Binary Alloys with a Limited Computational Budget."
In "Recent Progress and Modern Challenges in Applied Mathematics, Modeling and Computational Science," R. Melnik, R. Makarov, J. Belair (Eds.), Fields Institute Communications, 2016

6. Aldegunde, M., Kristensen, J., Zabaras N. (2016), "Quantifying uncertainties in first-principles alloy thermodynamics using cluster expansions."
Journal of Computational Physics

5. Kristensen, J., & Zabaras, N. (2015), "Predicting low-thermal-conductivity Si-Ge nanowires with a modified cluster expansion method." *Physical Review B*, **91**(5)

4. Kristensen, J., & Zabaras, N. (2014), "Bayesian uncertainty quantification in the evaluation of alloy properties with the cluster expansion method." *Computer Physics Communications*, **185**(11)

3. Kristensen, J., Bilionis, I., & Zabaras, N. (2013), "Relative entropy as model selection tool in cluster expansions."
Physical Review B, **87**(17)

2. Jensen, K. L., Kristensen, J. T., Crumrine, A. M., Andersen, M. B., Bruus, H., & Pennathur, S. (2011), "Hydronium-dominated ion transport in carbon-dioxide-saturated electrolytes at low salt concentrations in nanochannels." *Physical Review E*, **83**(5)

1. Kristensen, J. T., Houmann, A., Liu, X., & Turchinovich, D. (2008), "Low-loss polarization-maintaining fusion splicing of single-mode fibers and hollow-core photonic crystal fibers, relevant for monolithic fiber laser pulse compression." *Optics express*, **16**(13)

TALKS, CONFERENCES, & SEMINARS

- ASME IDETC/CIE (*coming up*) Summer 2018
- IGTI ASME, Oslo, NO Summer 2018
- AIAA Aviation and Aeronautics Forum and Exposition Summer 2018
- ASME V&V Spring 2018
- AIAA SciTech Forum, FL, US Winter 2018
- ASME V&V, Las Vegas, NV, US Spring 2017
- MODSIM world, VA Beach, US Spring 2017
- ASME IDETC/CIE, Charlotte, NC, US Summer 2016
- University of Cambridge (UK) - Isaac Newton Institute for Mathematical Sciences Fall 2015
  - Title: "Bayesian Uncertainty Quantification in Alloy Modelling and Design"
- Cornell University (Ithaca, NY, USA) Spring 2015
  - Title: "Uncertainty Quantification with Surrogate Models in Alloy Modeling"
- General Electric Company's Global Research Center Spring 2015
  - Title: "Quantifying and Propagating Uncertainties in Alloys for Materials Design"
- TMS (144th) (Orlando, FL, USA) – 2 talks given Spring 2015
  - Title (talk 1): "A modified Cluster Expansion Method for Non-Bulk Systems"
    Title (talk 2): "Predicting Low-Thermal-Conductivity Si-Ge Nanowires"
- (***invited***) University of Warwick (Coventry, UK) Winter 2015
  - Title: "Uncertainty Quantification with Surrogate Models in Alloy Modeling"
- (***invited***) University of Florida (Gainesville, FL, USA) Fall 2014
  - Title: "How Information Theory and the Bayesian Technology Can Help Computational Materials Science"
- Cornell University (Ithaca, NY, USA) Spring 2014
  - Title: "Quantifying Uncertainties in Alloy Properties"
- TMS (143rd) (San Diego, CA, USA) Spring 2014
  - Title: "Bayesian Model Selection in Cluster Expansions"
- SIAM on Uncertainty Quantification (Savannah, GA, USA) Spring 2014

- Title: "Uncertainty Quantification in Alloy Modeling"
- USNCCM (12th) (Raleigh, NC, USA) Summer 2013
  - Title: "A Novel Coupling of Information Theory and Thermodynamics in Alloy Modeling"
- (***invited***) TMS (142nd) (San Antonio, TX, USA) Spring 2013
  - Title: "Relative Entropy as Model Selection Tool in Cluster Expansions"

VISITING SCHOLAR (NON-DEGREE)

- University of Warwick, Coventry, UK Winter 2015
- University of Florida, Gainesville, FL, USA Fall 2014 & Spring 2015
- University of California, Santa Barbara, CA, USA Spring 2010
- Rensselaer Polytechnic Institute, NY, USA Fall 2009

HONORS AND AWARDS

GE Global Research Center
- Impact Award – GE GRC, Aviation, & Power (7/2018)
- Impact Award – GE GRC & BHGE (6/2018)
- Teaching Award – GE GRC (2/2018)
  in Probabilistic, Data Analytics, and Optimization Methods
- "Above and Beyond" award GE – Distributed Power (12/2016)
- "Above and Beyond" award GE – Aviation (6/2016)
- Admitted to hiring committee in the Probabilistics Lab – Research Center (4/2016)
- "Above and Beyond" – GE GRC (4/2016)

Cornell University
- Highest mark in qualifying exam of the Applied and Engineering Physics PhD class at Cornell University (2/2012)
- Henri S. Sack Memorial Award: "Top academic performance in Cornell's AEP MEng program 2010/2011" (7/2011)
- Vera & Carl Johan Michaelsens fund scholarship (12/2010)
- Reinholdt W. Jorck & Wife's Fund (11/2010)
- Civilingeniør Frants Allings Scholarship (9/2010)
- Oticon Fund (6/2010)
- Otto Mønsteds Fund (4/2010)
- MEC Fellowship (Master of Engineering Fellowship) (7/2010)
- Nominated for the Lester B. Knight Scholarship at Cornell University (2010)

Technical University of Denmark
- Published in the student's magazine: "*Krydsfelt*" (young publisher)

RESEARCH SOCIETIES

- Full member of Sigma Xi

COMMUNITY INVOLVEMENT

- Reviewer: Structural and Multidisciplinary Optimization
- Reviewer: The International Journal for Uncertainty Quantification
- Reviewer: The Journal of Computational Physics, Elsevier
- Reviewer: ASME IDETC/CIE conference 2016
- Contributor on the Alloy Theoretic Automated Toolkit forum (Computational Materials Science)
- I contribute to a scientific blog at: www.jespertoftkristensen.com
- Membership Chair – "Newcomers club" at GE GRC

PROGRAMMING LANGUAGES

Python, MatLab, R, Java, scripting (BASH mostly), linux environment (HPC, e.g.)