Samuel Chevalier

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Primary Research Objectives

Through my collaborative research activities, I seek to develop

1. computationally efficient **inverse problem** solvers for emerging power system applications;
2. rigorous yet practical **optimization** & **control** strategies for increasing renewable energy penetration;
3. analytical & **machine learning** based energy function solutions for **stabilizing** complex network systems.

Education

- **Massachusetts Institute of Technology (MIT)** — Cambridge, MA
  Doctor of Philosophy (PhD) in Mechanical Engineering (Power Systems) — *Aug. 2016 - Feb. 2021*
  - **Thesis:** *Inference, Estimation, and Prediction for Stable Operation of Modern Electric Power Systems*
  - **Committee**: Luca Daniel (advisor), Themis Sapsis (chair), Kotysta Turitsyn, Steve Leeb, Petr Vorobev

- **University of Vermont (UVM)** — Burlington, VT
  Master of Science (MS) in Electrical Engineering — *June 2015 - Aug. 2016*
  - **Thesis:** *Using Real Time Statistical Data to Improve Voltage Stability in Stochastic Power Systems*
  - **Committee**: Paul Hines (advisor), Taras Lakoba (chair), Mads Almassalkhi

- **University of Vermont (UVM)** — Burlington, VT
  Bachelor of Science (BS) in Electrical Engineering — *Aug. 2011 - June 2015*
  - Graduated *Magna Cum Laude* with 3.94/4.00 GPA; Minor in *Mathematics*

Selected Professional Appointments and Activities

- **Energy Analytics and Markets Group** — Lyngby, Denmark
  Postdoctoral Researcher at the Technical University of Denmark (DTU) — *Feb. 2021 - Present*
  - Working under Dr. Spyros Chatzivasileiadis in DTU's Center for Electric Power and Energy (CEE)
  - Developing frameworks for training physics informed neural networks for power system applications
  - Constructing rigorous verification tools for neural networks which generate performance guarantees
  - Training temporally distributed Deep Reinforcement Learning (DRL) agents to operate power systems

- **Computational Prototyping Group** — Cambridge, MA
  Graduate Research Assistant in the Electrical Engineering & Comp. Sci. Department at MIT — *Jan. 2019 - Jan. 2021*
  - Advised by Dr. Luca Daniel
  - Studied numerical simulation, inverse problem theory, and applied linear algebra
  - Developed advanced power system state estimation and dynamical inference solvers
  - Applied uncertainty quantification techniques for enhanced operation of power systems

- **Energy, Controls and Mechanics Research Nexus Group** — Cambridge, MA
  Graduate Research Assistant in the Mechanical Engineering Department at MIT — *Aug. 2016 - Dec. 2018*
  - Advised by Dr. Kostya Turitsyn
  - Studied control theory, system dynamics, and applied optimization
  - Investigated the propagation of forced oscillations in electrical power system networks
  - Derived a forced oscillation source location solver using Bayesian inversion
  - Characterized the stability of various energy networks (e.g. natural gas pipeline systems, microgrids) using novel simulation and energy function analysis techniques

- **Energy and Complexity Research Group** — Burlington, VT
  Under/Graduate Research Assistant in the Electrical Engineering Department at UVM — *Jan 2014 - Aug. 2016*
  - Advised by Dr. Paul Hines
  - Explored the statistical warning signs of voltage instability in transmission networks
  - Constructed a reactive power controller which used PMU data statistics as a feedback signal

- Performed data sanitation and organization in a DOE-sponsored demand response study

- **Graduate and Undergraduate Teaching Assistant (TA)** Burlington, VT
  Instructor for Electrical Engineering Labs at UVM *2014 - 2016*
  - EE81: Linear Circuits 1 (1x)
  - EE113: Introduction to Electrical Energy Systems (3x)

- **Graduate Resident Advisor (GRA)** Cambridge, MA
  Mentor for Undergraduates at MIT *Aug. 2017 - Jan. 2021*
  - Supported 40 undergraduate students as a live-in resource on a residential hall
  - Resolved interpersonal conflict, built community, and acted as a mental health resource

- **Veritas' Graduate School Mentorship Program** Cambridge, MA
  Electrical Engineering Intern *March, 2020 - Present*
  - Actively mentored and prepared undergraduate students from top US schools (Yale, UC Berkeley, Duke, etc.) for applying to PhD programs

- **LORD Microstrain** Williston, VT
  Electrical Engineering Intern *Summer 2013 and 2014*
  - Developed software in LabVIEW for calibrating wireless sensor nodes and networks
  - Performed sensor prototype assembly and subsequent wireless packet transmission testing

- **Academic Reviewer** *2015-Present*
  - IEEE Transactions on Power Systems
  - IEEE Transactions on Smart Grid
  - IEEE Power and Energy Society General Meeting (PESGM)
  - IEEE Power Engineering Letters
  - IEEE Control System Letters
  - IET Generation, Transmission & Distribution
  - American Control Conference (ACC)

Relevant Skills

- **Programming Tools:** MATLAB (expert), Python, Julia, C, PowerWorld, Power System Analysis Toolbox (PSAT), OpenDSS, MATPower, LabVIEW, PSpice, Arduino, LaTeX, PSS/E (novice)
- **Mathematical Tools:** linear algebra, differential equations, inverse problem theory, Bayesian inversion, power system and circuit analysis, applied optimization, control theory, mechanical dynamics, electromagnetics, model order reduction, numerical simulation, statistics, stochastic processes, uncertainty quantification
- **Interpersonal Skills:** Strong written and oral communication skills; active listening skills; trained in Restorative Practices (RP); extensive coaching and mentoring experiences in a diversity of contexts

Honors and Awards

⋆ America East Presidential Scholar Recipient (2015)
⋆ Senior Electrical Engineering Award: Atwater-Kent Award for Excellence of Judgment and Understanding of the Principles of Electrical Engineering (2015)
⋆ Tau Beta Pi Honor Society Inductee (2014)
⋆ American Public Power Association Scholarship (2014)
⋆ Recipient of the Richard A. Swenson Endowed Scholarship (2013 - 2014)
⋆ Sophomore Electrical Engineering Award: Excellence and Greatest Promise (2013)
⋆ Recipient of the Vermont Scholar's Award Scholarship (2011-2014)

Selected Publications

1. T. Bradde, **S. Chevalier**, M. De Stefano, S. Grivet-Talocia, and L. Daniel, "Handling Initial Conditions in Vector Fitting for Real Time Modeling of Power System Dynamics." *Submitted to MDPI Energies.*
2. **S. Chevalier**, K. Cavanagh, K. Turitsyn, L. Daniel, and P. Vorobev, "Stability Certification Standards for DC Microgrid Networks with Arbitrary Load Configurations." *Submitted to IEEE Transactions on Power Systems.*
3. **S. Chevalier**, L. Schenato, and L. Daniel, "Probabilistic Power Flow in Distribution Networks via Model Reduction and Neumann Expansion." *Submitted to IEEE Transactions on Power Systems.*
4. **S. Chevalier** and D. Wu, "Dynamic Linepack Depletion Models for Natural Gas Pipeline Networks," in Applied Mathematical Modelling, vol. 94, pp. 169-186, 2021, doi: https://doi.org/10.1016/j.apm.2020.12.022
5. **S. Chevalier**, L. Schenato, and L. Daniel, "Accelerated Probabilistic State Estimation in Distribution Grids via Model Order Reduction." Accepted for publication at the 2021 IEEE Power & Energy Society General Meeting (PESGM). ArXiv e-print: 2011.05397.
6. A. Mikhalev, A. Emchinov, **S. Chevalier**, Y. Maximov and P. Vorobev, "A Bayesian Framework for Power System Components Identification," 2020 IEEE Power & Energy Society General Meeting (PESGM), Montreal, QC, Canada, 2020, pp. 1-5, doi: 10.1109/PESGM41954.2020.9281790.
7. **S. Chevalier**, P. Vorobev and K. Turitsyn, "A Passivity Interpretation of Energy-Based Forced Oscillation Source Location Methods," in IEEE Transactions on Power Systems, vol. 35, no. 5, pp. 3588-3602, Sept. 2020, doi: 10.1109/TPWRS.2020.2973070.
8. D. Wu, P. Vorobev, **S. Chevalier** and K. Turitsyn, "Modulated Oscillations of Synchronous Machine Nonlinear Dynamics With Saturation," in IEEE Transactions on Power Systems, vol. 35, no. 4, pp. 2915-2925, July 2020, doi: 10.1109/TPWRS.2019.2958707.
9. **S. Chevalier**, P. Vorobev, K. Turitsyn, B. Wang and S. Maslennikov, "Using Passivity Theory to Interpret the Dissipating Energy Flow Method," 2019 IEEE Power & Energy Society General Meeting (PESGM), Atlanta, GA, USA, 2019, pp. 1-5, doi: 10.1109/PESGM40551.2019.8974116.
10. P. Vorobev, **S. Chevalier** and K. Turitsyn, "Decentralized stability rules for microgrids," 2019 American Control Conference (ACC), Philadelphia, PA, USA, 2019, pp. 2596-2601, doi: 10.23919/ACC.2019.8815214.
11. **S. Chevalier**, P. Vorobev and K. Turitsyn, "A Bayesian Approach to Forced Oscillation Source Location Given Uncertain Generator Parameters," in IEEE Transactions on Power Systems, vol. 34, no. 2, pp. 1641-1649, March 2019, doi: 10.1109/TPWRS.2018.2879222.
12. **S. Chevalier**, P. Vorobev and K. Turitsyn, "Using Effective Generator Impedance for Forced Oscillation Source Location," in IEEE Transactions on Power Systems, vol. 33, no. 6, pp. 6264-6277, Nov. 2018, doi: 10.1109/TPWRS.2018.2834229.
13. **S. Chevalier** and P. D. H. Hines, "Mitigating the Risk of Voltage Collapse Using Statistical Measures From PMU Data," in IEEE Transactions on Power Systems, vol. 34, no. 1, pp. 120-128, Jan. 2019, doi: 10.1109/TPWRS.2018.2866484.
14. **S. Chevalier** and P. D. H. Hines, "Identifying system-wide early warning signs of instability in stochastic power systems," 2016 IEEE Power and Energy Society General Meeting (PESGM), Boston, MA, 2016, pp. 1-5, doi: 10.1109/PESGM.2016.7741815.