# Alp Dener

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## Research Interests

**Optimization**: PDE-constrained Problems, Gradient-based Algorithms, Sensitivity Analysis, MDO Architectures
**Machine Learning**: Physics Informed Neural Networks, Constrained Training Methods, Supervised Learning
**Scientific Computing**: High Performance Computing for Optimization, Reusable Scientific Software

## Education

**Rensselaer Polytechnic Institute**                                                December 2017
  Aeronautical Engineering, Ph.D.
**University of Maryland, Baltimore County**                                            May 2012
  Mechanical Engineering, B.S.

## Work Experience

**Postdoctoral Appointee – Argonne National Laboratory**                    Feb 2018–Present
  *Mathematics and Computer Science Division*                          Supervisor: Todd Munson
  o Principal developer on Toolkit for Advanced Optimization (TAO) and contributor to PETSc
  o Research large-scale optimization algorithms with efficient treatment of nonlinear constraints
  o Promote TAO, expand its user base, and provide software support for external researchers
**Graduate Research Assistant – Rensselaer Polytechnic Institute**          Feb 2013–Dec 2017
  *Optimal Design Lab*                                            Supervisor: Jason E. Hicken
  o Investigate PDE-constrained multi-disciplinary design optimization problems
  o Research gradient-based, reduced-space, matrix-free optimization algorithms
  o Develop a parallel-agnostic optimization library tailored for large-scale engineering systems
**Undergraduate Research Assistant – University of Maryland, Baltimore County**    Oct 2010–May 2011
  *Joint Center for Earth Systems Technology*                      Supervisor: Gergely Dolgos
  o Construction of an optical aerosol measurement instrument
  o Design and manufacture of high-precision optical component mounts
  o Propose instrument mounting solutions for the NASA GSFC science fleet aircraft

## Honors & Awards

o AIAA Student Paper Competition - 1st Place                                            2018
  - Category: Multidisciplinary Analysis and Optimization

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# Publications and Presentations

## Journal Articles

**Dener, Alp, M Andres Miller, et al.** (2020). "Training neural networks under physical constraints using a stochastic augmented Lagrangian approach (submitted)". In: *Journal of Computational Physics*.

**Miller, M Andres et al.** (2020). "Encoder-decoder neural network for solving the nonlinear Fokker-Planck-Landau collision operator in XGC (accepted)". In: *Journal of Plasma Physics*.

**Mills, Richard Tran et al.** (2020). "Toward Performance-Portable PETSc for GPU-based Exascale Systems (submitted)". In: *IEEE Transactions on Parallel and Distributed Systems (Special Section on Innovative R&D toward the Exascale Era)*.

**Dener, Alp and Jason E Hicken** (2017). "Matrix-free Algorithm for the Optimization of Multidisciplinary Systems". In: *Structural and Multidisciplinary Optimization, Springer*. DOI: 10.1007/s00158-017-1734-0.

**Hicken, Jason E and Alp Dener** (2015). "A Flexible Iterative Solver for Nonconvex, Equality-constrained Quadratic Subproblems". In: *Journal on Scientific Computing, SIAM*. DOI: 10.1137/140994496.

## Refereed Proceedings

**Dener, Alp, Adam Denchfield, and Todd Munson** (June 2019). "Preconditioning nonlinear conjugate gradient with diagonalized quasi-Newton". In: *Proceedings for the Platform for Advanced Scientific Computing Conference*. Zurich, Switzerland. DOI: 10.1145/3324989.3325712.

**Dener, Alp and Todd Munson** (June 2019). "Accelerating Limited-Memory Quasi-Newton Convergence for Large-Scale Optimization". In: *International Conference on Computational Science*. Faro, Portugal. DOI: 10.1007/978-3-030-22744-9_39.

**Dener, Alp, Jason E Hicken, et al.** (June 2018). "Enabling Modular Aerostructural Optimization: Individual Discipline Feasible without the Jacobians". In: *2018 Multidisciplinary Analysis and Optimization Conference, AIAA AVIATION Forum*. Atlanta, GA, USA. DOI: 10.2514/6.2018-3570.

**Dener, Alp, Pengfei Meng, et al.** (Jan. 2016). "Kona: A Parallel Optimization Library for Engineering-Design Problems". In: *57th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, AIAA SciTech Forum*. San Diego, CA, USA. DOI: 10.2514/6.2016-1422.

**Dener, Alp, Gaetan K W Kenway, et al.** (Jan. 2015). "Comparison of Inexact- and Quasi-Newton Algorithms for Aerodynamic Shape Optimization". In: *53rd AIAA Aerospace Sciences Meeting, AIAA SciTech Forum*. Kissimmee, FL, USA. DOI: 10.2514/6.2015-1945.

**Dener, Alp and Jason E Hicken** (Jan. 2014). "Revisiting Individual Discipline Feasible with matrix-free Inexact-Newton-Krylov". In: *10th AIAA Multidisciplinary Design Optimization Conference, AIAA SciTech Forum*. National Harbor, MD, USA. DOI: 10.2514/6.2014-0110.

## Technical Reports

**Balay, Satish et al.** (2020). *PETSc Users Manual*. Tech. rep. ANL-95/11 - Revision 3.14. Argonne National Laboratory.

**Dener, Alp et al.** (2020). *TAO Users Manual*. Tech. rep. ANL/MCS-TM-322 - Revision 3.14. Argonne National Laboratory.

## Preprints / Working Papers

**Dener, Alp, Adam Denchfield, and Todd Munson** (2021). "The TAO Nonlinear Conjugate Gradient and Quasi-Newton Laboratory (in preparation)". In: *arXiv preprint*.

**Dener, Alp, Todd Munson, et al.** (2021). "Toward Constrained Optimization in Machine Learning: An Error-Tolerant Multisecant Method for Training PINNs (in preparation)". In: *arXiv preprint*.

**Hicken, Jason E, Pengfei Meng, and Alp Dener** (2017). "Error-tolerant multisecant method for nonlinearly constrained optimization". In: *arXiv preprint arXiv:1709.06985*.

## Conference Presentations

**Dener, Alp, Todd Munson, et al.** (Mar. 2021). *Toward Constrained Optimization in Machine Learning: An Error-Tolerant Multisecant Method for Training PINNs*. SIAM Conference on Computational Science and Engineering.

**Dener, Alp** (Feb. 2020). *Investigating Quasi-Newton Outer Product Representations on GPUs*. SIAM Conference on Parallel Processing for Scientific Computing.

**Dener, Alp, Adam Denchfield, and Todd Munson** (Feb. 2019). *Acelerating Quasi-Newton and Conjugate Gradient Convergence for Large-Scale Optimization*. SIAM Conference on Computational Science and Engineering.

## Doctoral Thesis

**Dener, Alp** (Dec. 2017). "A Modular Matrix-free Approach to Multidisciplinary Design Optimization". PhD thesis. Rensselaer Polytechnic Institute.

## Proposal Contributions

- **"Development of a Machine Learning Toolkit in PETSc"**, co-investigator, LDRD Prime - Future Computing, 2021-0177, 2021, (funded)
- **"Frameworks, Algorithms and Scalable Technologies for Mathematics (FASTMath) SciDAC Institute"**, numerical optimizations expert, DOE-ASCR, LAB 20-2223, 2020, (funded)
- **"Machine Learning and Artificial Intelligence for Simulation Acceleration and Real-Time Scientific Discovery of Fusion Science on Exascale Computers (MASS)"**, numerical optimization expert, DOE-FES, LAB 20-2224, 2020, (not funded)
- **"Machine learning enhanced sampling methods for the stochastic multi-fidelity optimization of complex systems"**, numerical optimization expert, DOE-ASCR, LAB 20-2321, 2020, (not funded)

## Professional Activities and Service

**Referee/Reviewer**
- Mathematics of Optimization Research (2018-)
- SIAM Journal on Scientific Computing (2018-)
- Optimization and Engineering (2018-)
- AIAA Journal (2018-)
- DOE SBIR Phase I Review Panel (2019)

**Conference Service**
- Session Organizer: SIAM CSE19, SIAM CSE21

**Argonne Training Program for Extreme-Scale Computing**
- Lead Organizer, Numerical Software Track (2021-)
- Organizer, Numerical Software Track (2020)
- Lecturer, Numerical Software Track (2019-)

**National Science Bowl**
- Questions Judge, Illinois Regionals (2021)

**Societies**
- American Institute of Aeronautics and Astronautics (2012-)
- Society of Industrial and Applied Mathematics (2012-)
- Mathematical Optimization Society (2018-)
- Institute for Operations Research and the Management Sciences (2018-)

**Givens Associates**
- Jamal Shabani, Louisiana State University (2021)
- Han Sol Suh, Georgia Institute of Technology (2019)