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LinkedIn Profile
GitHub Portfolio
Google Scholar

Ahmed Bayoumy, PhD

Education

2019 **PhD**, *McGill University*, Montreal
Mechanical Engineering Department, Systems Optimization Lab

A Relative Adequacy Framework for Multi-model Management in Single- and Multi-disciplinary Design Optimization

2014 **MSc**, *Cairo University*, Egypt
Mechanical Design and Production Engineering

Modeling and Simulation of Large-Size Wind Turbine Blades Geometry Using Absolute Nodal Coordinate Formulation with Enhancement of its Performance

2008 **BEng**, *Benha University*, Egypt
Mechanical Engineering Department

Research Interests

Applied optimization and AI: multidisciplinary design optimization (MDO) of complex engineering systems, derivative-free and blackbox optimization, Bayesian and surrogate-based optimization, automated machine learning (AutoML) and hyperparameter optimization, uncertainty-aware machine learning, distributed and multi-agent optimization, and robust optimization of engineering systems.

Teaching Experience

2026 (Fall) **Course Lecturer**, *MECH 559: Engineering Systems Optimization*, McGill University, Montreal, Canada

- Instructor of record for a graduate/senior undergraduate course on engineering systems optimization.
- Design and deliver lectures, assignments, and assessments covering optimal design principles, single- and multidisciplinary optimization formulations, and derivative-free optimization methods.
- Apply an experiential, project-based approach in which students formulate and solve realistic engineering design optimization problems.
- Course notebooks published openly on GitHub [Course Repository]

2022–2024 **Guest Lecturer**, *MECH 559: Engineering Systems Optimization*, McGill University, Montreal, Canada

- 2022–2025: Guest lecture on Derivative-Free Optimization [Slides]
- 2022: Guest lecture on Multidisciplinary Design Optimization [Notebook]

2016–2019 **Teaching Assistant**, *McGill University*, Montreal, Canada

- MECH 559: Engineering Systems Optimization (2016, 2019)
- MECH 501, 502: Analysis, Synthesis and Optimization of Engineering Systems (2017, 2019)
- MECH 290: Design Graphics for Mechanical Engineering using SolidWorks (2017–2019)
- MECH 292: Conceptual Design (2016, 2018)
- MECH 539: Computational Aerodynamics (2016)
- MECH 400: Engineering Professional Practice (2018–2019)

Research Experience

2025-present **AI-driven Systems MDO**, *Siemens DISW and McGill*, Montreal, Canada

- Funded Mitacs Accelerate project with Prof. Kokkolaras.
- Data-driven systems design and optimization in distributed MDO architectures.
- AI-based coordination accelerators.
- Bayesian systems design and optimization.
- Auto selection and tuning of models during the design process.

2023-present **Uncertainty-aware AI-accelerators for Blackbox Optimization (BBO)**, *Siemens DISW*, Montreal, Canada

- Assess trustworthiness of the uncertainty-aware AI model predictions during the BBO process.
- Leverage the design performance of best designs found without hurting the acceleration benefit of using AI models.
- Break-off possible pre-mature convergence (plateau) of design performance when AI models predictions are excessively used to evaluate critical design candidates.
- Use our proposed AutoML approach to manage the auto-selection and auto-tuning of AI models.

2023-2024 **Systems Multidisciplinary Analysis and Design Optimization**, *Advanced Numerical Methods Engineer and Optimization Specialist*, (Solution Blog), Siemens DISW, Montreal, Canada

- Adopt my open source DMDO Python package as a back-end to enable collaborative distributed optimization with SimCenter HEEDS tool.
- Adopt the non-hierarchical analytical target cascade (NHATC) to solve distributed MDO problems.
- Visualize, setup, and decompose MDO workflows using an interactive design structure matrix (DSM) front-end.
- Enable design coordination in parallel execution mode.

2022-2023 **Distributed AutoML**, *Advanced Methods Engineer and Optimization Specialist*, Siemens DISW and McGill, Montreal, Canada

- Develop methods to solve the distributed combined algorithm selection and mixed hyperparameter optimization (CASH)
- Cluster the configuration space to improve sampling efficiency.
- Test the proposed methods on standard benchmark problems.
- Apply the proposed approaches to uncertainty-aware AI models.

2020-2023 **Improve algorithmic performance of Siemens SimCenter HEEDS solvers**, *Advanced Numerical Methods Engineer and Optimization Specialist*, Siemens DISW, Montreal, Canada

- Enhance the performance of algorithms for solving high-dimensional problems.
- Accelerate design progress during the optimization process.
- Design and implement a benchmarking suite to statistically evaluate algorithm performance and performance indicators on various single- and multi-objective design optimization problems under different random states.

2018–2020 **Distributed Multidisciplinary Analysis and Design Optimization (DMADO)**, *NSERC CRD Research Assistant*, Siemens, McGill, and École de technologie supérieure (ETS), Montreal, Canada

- Develop a distributed multidisciplinary design optimization (DMDO) Python package to solve MDO problems using a penalty-based distributed interdisciplinary feasible (IDF) formulation, specifically the non-hierarchical analytical target cascading (NHATC) method.
- Utilize the DMDO package to automate and accelerate the convergence of feedback coupling between multiple components.
- Configure the MDO workflow for selected design components of aero-derivative gas turbine engines (AGT) using two MDO architectures: monolithic multidisciplinary feasible (MDF) and IDF approaches.
- Integrate the developed DMDO package with Siemens software solutions, including Siemens SimCenter HEEDS.

2015–2019 **A Relative Adequacy Framework for Multimodel Management in Single- and Multidisciplinary Design Optimization**, *Research Assistant*, McGill, Montreal, Canada

- Formulate a relative adequacy framework (RAF) to address the trade-off between models' adequacy (usefulness) and their estimated computational cost in a design optimization context.
- Accelerate the design optimization process utilizing the RAF while maintaining, or even improving, the trajectory of design performance.
- Manage the selection, execution, and rectification of available computational models throughout the design optimization process.
- Design two algorithms for solving multifidelity time-invariant multidisciplinary design optimization (MDO) problems using RAF.
- Design an algorithm for solving multifidelity time-dependent MDO problems using RAF.

Employment History

2026–present **Course Lecturer**, *McGill University*, Montreal, Canada

Teaching courses related to engineering design optimization, artificial intelligence, and multidisciplinary design optimization (MDO).

2020–present **Advanced Software Engineer and Optimization Specialist**, *Siemens Digital Industries Software*, Montreal, Canada

- Contribute to developing innovative engineering design and optimization software solutions.
- Implement cutting-edge technologies and research findings related to Multidisciplinary Design Optimization (MDO), artificial intelligence (AI), simulation-based optimization, and derivative-free optimization.
- Propose and develop approaches, strategies and solutions for pressing technical challenges associated with engineering design optimization, AI and MDO such as:
  - Hierarchical and non-hierarchical MDO
  - Nonhierarchical coordination among distributed agents
  - AI-driven MDO
  - Automated machine learning (AutoML)
  - Uncertainty quantification
  - Multifidelity models
  - Knowledge-based optimization
  - Derivative free optimization
  - Reduced order models (ROMs) and data-driven dynamics
  - Influence studies
  - Benchmarking
- Work in Agile environment; utilize Agile scrum practices.

2017–2020 **Research Assistant**, *Siemens Energy*, Montreal, Canada

- Algorithms design and development of distributed MDO architectures and optimization methods that reinforce decision-making in the design process of aeroderivative gas turbine engines.
- Implement state-of-the-art technologies and research findings in process automation, simulation-based optimization and derivative-free optimization.
- Integrate the developed methods into Siemens technology software packages (SimCenter and HEEDS):
  - AutoOpti and Moika
  - Process chain
  - ACES
  - NX open
- Work in Agile environment; utilize Agile scrum practices.

2012–2015 **Engineering Group Leader**, *Power Generation Engineering and Services Company (PGESCo), BECHTEL corporation*, Cairo, Egypt

- Developed a finite element analysis and design application software package; Pipe Supports Design and Analysis (PSD), based on linear structural analysis and international design codes and standards.
- Contributed to the coordination and integration of combustion turbine and steam turbine packages for combined cycle plants and boiler-STG packages for thermal power plants, co-generation plants, and gas- and oil-fired plants.
- Contributed to developing design guides for conducting structural, flow, and fluid-structure interaction analyses for critical systems at off-design conditions and different modes of plant operation, e.g., start-up, trip, and shut-down.

2010–2012 **Mechanical Design Engineer**, *EIE Group Company*, Cairo, Egypt

- Specialist of piping design and stress analysis.
- Reverse engineering using FARO laser scanning arm and GEOMAGIC (see also Teaching Experience above).

Leadership and Supervision

2023–present **Supervisor and Mentor of Research Interns**, *Siemens DISW*, Montreal, Canada

2023–present **Research and Development Projects Scrum Master**, *Siemens DISW*, Montreal, Canada

2019–2020 **Research Group leader**, *Siemens*, Montreal, Canada

2014–2015 **Deputy Engineering Group Supervisor**, *PGESCo, BECHTEL corporation*, Cairo, Egypt, Hydraulic and Transient Analysis Group

2013–2014 **Plant Design Engineering Group Leader**, *PGESCo, BECHTEL corporation*, Cairo, Egypt, Stress Analysis Central Group

2012–2013 **Mechanical Engineering Group Leader**, *PGESCo, BECHTEL corporation*, Cairo, Egypt, Design Review Central Group

Awards

2015–2018 **McGill Engineering Doctoral Awards (MEDA)**, *McGill University*, Montreal, Canada
It is awarded in the amount of $37,000 CAD each year for three academic years, a total value of $111,000 CAD.

Articles in Archival Journals

Articles Under Review

[1] Bayoumy, A. Algorithm XXXX: OMADS: A Python Implementation of the Mesh Adaptive Direct Search Algorithm for Constrained and Multiobjective Blackbox Optimization. *ACM Transactions on Mathematical Software*, under review. [Code]

Manuscripts in Preparation

[1] Bayoumy, A. and Kokkolaras, M. A Hierarchical Design Structure Diagram for Distributed Multidisciplinary Design Optimization. In preparation for *Structural and Multidisciplinary Optimization*, Springer.

[2] Bayoumy, A. and Kokkolaras, M. Bayesian Learning-based Enhancement of Augmented Lagrangian Coordination for Distributed Multidisciplinary Design Optimization. In preparation for *Journal of Aircraft Design*, AIAA.

[3] Bayoumy, A. and Kokkolaras, M. An Adaptive Hybrid of Reduced-Space Tree-Structured Parzen Estimators and a Model-Free Trust Region for High-Dimensional Black-Box Optimization. In preparation for a SIAM journal.

Articles in Conference Proceedings

[1] T. Peoc'h, A. Bayoumy, M. Staniszewski, H. Moustapha, M. Kokkolaras, and F. Garnier. Integration of Secondary Air System for Multidisciplinary Design Optimization of Gas Turbines. In *AERO2019*, Laval, Quebec, Canada, 2019. Canadian Aeronautics and Space Institute.

[2] A. Bayoumy and M. Kokkolaras. A Relative Adequacy Framework for Multimodel Management in Multidisciplinary Design Optimization. In *Multidisciplinary Analysis and Optimization Conference*, Atlanta, Georgia, USA, 2018. AIAA.

[3] A. Bayoumy and M. Kokkolaras. A Reference Error Formulation for Multi-fidelity Design Optimization. In *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, volume 58134, Cleveland, Ohio, USA, 2017. ASME.

[4] A. Papadopoulos, M. Ismail, and A. Bayoumy. Dynamic Amplification Factor for Rigid

and Flexible Piping System due to Steam Hammer Transient Load. In *ASME International Mechanical Engineering Congress and Exposition*, volume 57397, Houston, Texas, USA, 2015. ASME.

[5] A. Bayoumy and A. Papadopoulos. Time History Steam Hammer Analysis for Critical Hot Lines in Thermal Power Plants. In *International Mechanical Engineering Congress and Exposition*, page 11, Montreal, Quebec, Canada, 2014. ASME.

[6] A. Bayoumy, A. Nada, and S. Megahed. Use of Forward Dynamics Model for Designing Large-size Wind Turbine Blades. In *ASME International Mechanical Engineering Congress and Exposition*, volume 56253, San Diego, California, USA, 2013. ASME.

[7] A. Bayoumy, A. Nada, and S. Megahed. Modeling Slope Discontinuity of Large Size Wind-turbine Blade Using Absolute Nodal Coordinate Formulation. In *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, volume 45059, pages 105–114, Chicago, Illinois, USA, 2012. ASME.

Under Review

[1] Bayoumy, A. and Kokkolaras, M. Uncertainty-Aware Relative Adequacy Framework for Multifidelity Distributed Multidisciplinary Design Optimization of Wind Turbine Blades. ASME Turbo Expo 2027, Paper No. GT2027-200150. Under review.

Workshops and Conference Talks

2026 **3rd AIAA Workshop on Multifidelity Methods for Design and Uncertainty Quantification** , *AIAA, Chicago, USA*, Workshop Link, Workshop Agenda

2025 **Interview on the Role of Strategic AI in Engineering Design of Complex Systems**, *Siemens Internal Communications*, Siemens DISW, Lyon, France

2024 **Multidisciplinary Design Optimization**, *Learning Day Session*, Siemens DISW, Montreal, Canada

2022 **2nd AIAA Workshop for Multifidelity Modeling in Support of Design and Uncertainty Quantification**, *AIAA, Chicago, USA*, Workshop Link

Reviewer

2024-present **Scientific Reports, Springer**
2022-present **Journal of Computational Science, Springer**
2020-present **ASME Journal of Mechanical Design**
2020-present **Structural and Multidisciplinary Optimization journal, Springer**
2015-present **Journal of Multi-body Dynamics, SAGE**

Technical Committees Membership

2025-present **MDO technical committee, AIAA**, *Member of Education, Research, and Benchmarking Subcommittees*

Open source code library

I participated in the development of academic and industrial software projects that help reinforce engineering decision making in complex systems. I authored open-source codes that have been used in various research projects. Including, but not limited to, six python packages that can work together to manage the use of multiple models during design optimization. Each developed package can work per se to provide its function in other design exploration and exploitation contexts. The codes are maintained on the following GitHub repositories:

- Engineering Systems Optimization (MECH559) Course Notebooks [Link]
- Single- and Multi-Objective Derivative-Free Blackbox Optimization Package: Optimization using Mesh Adaptive Direct Search (OMADS) [Link] [OMADS Documentation]
- Distributed Multidisciplinary Design Optimization (DMDO) [Link] [DMDO Documentation]
- Data-Driven Models for Optimization (ddmo): Kriging, RBF, response surfaces, and ensembles [Link] [ddmo Documentation]
- Samplers Library (samplersLib) [Link]
- Relative Adequacy Framework (RAF) [Link]
- Uncertainty-Aware Relative Adequacy Framework (UARAF) [Link]

Technical Skills

Programming C, C++, Python (NumPy, SciPy, scikit-learn), Julia; scientific software and package design, documentation, and testing

AI / ML Surrogate models (Gaussian processes, Kriging, radial basis functions), AutoML and CASH, uncertainty quantification, reduced order models

Optimization Mesh adaptive direct search (MADS), Bayesian optimization, evolutionary and multi-objective algorithms, trust-region methods, ADMM-based distributed coordination

Practices Agile/Scrum (Scrum Master), Git and GitHub, benchmarking and statistical performance evaluation

Languages

English Fluent
French Basic
Arabic Native