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Ahmed-Bayoumy
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Ahmed Bayoumy, PhD

Education

2015–2019 **PhD**, *McGill University*, Montreal
Mechanical Engineering Department, Systems Optimization Lab

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

2010–2014 **MSc**, *Cairo University*, Egypt
Mechanical Design and Production Engineering

Thesis 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 Projects

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

- Manage the use of multiple computational models for analysis in a numerical optimization context.
- Design an algorithm combining the use of error surrogates, relative adequacy spaces, trust region techniques and derivative-free optimization for solving multifidelity single-disciplinary optimization problems.
- Design two algorithms that extend the algorithm mentioned in the previous item for solving multifidelity time-invariant multidisciplinary design optimization (MDO) problems.
- Design an algorithm for solving multifidelity time-dependent MDO.

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

- Develop a python package (DMDO) for running MDO problems using a penalty-based distributed interdisciplinary feasible (IDF) formulation known as non-hierarchical analytical target cascading (NHATC.)
- Utilize DMDO to automate and accelerate the convergence of the feedback coupling between among multiple components.
- Set up the MDO workflow of the aero-derivative gas turbine engines (AGT) components using two MDO architectures: monolithic multidisciplinary feasible (MDF) and IDF approaches.
- Integrate the developed DMDO into Siemens software packages (SimCenter and HEEDS).

2022-2023 **Improve algorithmic performance of HEEDS solvers**, *Advanced Methods Engineer and Optimization Specialist*, Siemens DISW, Montreal, Canada

- Improve algorithms performance for solving high-dimensional problems
- Accelerate design performance improvement during the optimization process
- Design and implement a benchmarking suite that aims to statistically infer algorithms performance on various problems given different random states

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)
- Run distributed CASH studies actively online during a running process
- Cluster the configuration space for better sampling
- Test the proposed methods on standard benchmarking problems
- Apply the proposed approaches on uncertainty aware AI models

2024-present **AI-driven systems MDO**, *Mitacs accelerate (preparation and planning phase)*, Siemens DISW and McGill, Montreal, Canada

- Data-driven systems design and optimization in distributed architectures
- AI-based coordination accelerators
- Bayesian systems design and optimization
- Auto selection and tuning of models during the design process

Employment History

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

- Contribute to the development of HEEDS MDO framework and the algorithmic design and development of constituted optimization methods.
- Implement state-of-the-art technologies and research findings in MDO, simulation-based optimization and derivative-free optimization.
- Propose and develop approaches, strategies and solutions for pressing technical challenges associated with MDO such as:
  - Hierarchical and non-hierarchical MDO
  - Nonhierarchical coordination among distributed agents
  - AI-driven MDO
  - Automated machine learning (AutoML)
  - Uncertainty quantification
  - Multifidilty 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 Associate**, *Siemens Energy*, Montreal, Canada

- Algorithms design and development of distributed MDO architectires 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 **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

- Instructor for mechanical modeling and dynamic simulation using UNIGRAPHICS NX, AUTODESK INVENTOR, and ANSYS.
- Reverse engineering; modeling using FARO laser scanning arm and GEOMAGIC.
- Specialist of piping design and stress analysis.

Leadership and Supervision

2023–present **Supervisor and Mentor of Interns**, *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

[1] A. Bayoumy and M. Kokkolaras. Multi-model Management for Time-dependent Multidisciplinary Design Optimization Problems. *Structural and Multidisciplinary Optimization*, 61(5):1821–1841, 2020.

[2] A. Bayoumy and M. Kokkolaras. A Relative Adequacy Framework for Multimodel Management in Multidisciplinary Design Optimization. *Structural and Multidisciplinary Optimization*, 62(4):1701–1720, 2020.

[3] A. Bayoumy and M. Kokkolaras. A Relative Adequacy Framework for Multi-Model Management in Design Optimization. *Journal of Mechanical Design*, 142(2), 2019.

[4] A. Bayoumy, A. Nada, and S. Megahed. Methods of Modeling Slope Discontinuities in Large Size Wind Turbine Blades using Absolute Nodal Coordinate Formulation. *Proceedings of the Institution of Mechanical Engineers, Part K: Journal of Multi-body Dynamics*, 228(3):314–329, 2014.

[5] A. Bayoumy, A. Nada, and S. Megahed. A Continuum Based Three-Dimensional Modeling of Wind Turbine Blades. *Journal of Computational and Nonlinear Dynamics*, 8(3), 2012.

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.

Workshop Talks and Guest Lectures

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

2022 **MECH 559: Engineering Systems Optimization**, *McGill University, Montreal, Canada*

Reviewer

2020, present **Structural and Multidisciplinary Optimization journal, Springer**

2020, present **ASME Journal of Mechanical Design**

2022, present **Journal of Computational Science, Springer**

2024, present **Scientific Reports, Springer**

Teaching Assistant

2016, 2019 **MECH 559: Engineering Systems Optimization**, *McGill University, Montreal, Canada*

2017, 2019 **MECH 501, 502: Analysis, Synthesis and Optimization of Engineering Systems**, *McGill University, Montreal, Canada*

2017-2019 **MECH 290: Design Graphics for Mechanical Engineering using SolidWorks**, *McGill University*, Montreal, Canada

2016, 2018 **MECH 292: Conceptual Design**, *McGill University*, Montreal, Canada

2016 **MECH 539: Computational Aerodynamics**, *McGill University*, Montreal, Canada

2018–2019 **MECH 400: Engineering Professional Practice**, *McGill University*, Montreal, Canada

Open source code library

I participated in the development of academic and industrial software projects that help reinforce decision making in complex systems. I authored open-source codes that have been used in various research projects. Including, but not limited to, five 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:

- Single- and Multi-Objective Derivative-Free Blackbox Optimization Package: Orthogonal Mesh Adaptive Direct Search (OMADS) [Link] [OMADS Documentation]
- Distributed Multidisciplinary Design Optimization (DMDO) [Link] [DMDO Documentation]
- Surrogate Models Library (SML) [Link]
- Samplers Library (samplersLib) [Link]
- Relative Adequacy Framework (RAF) [Link]

Languages

English	Fluent
French	Basic
Arabic	Native