Kapil Khanal

5074910407 | kk733@cornell.edu | kapilkhanal.github.io

Computational and data science professional specializing in building data systems and decision-making tools to optimize engineering systems.

Education

Cornell University Ithaca, NY

Ph.D. Candidate, Systems: (Applied Mathematics / Computational Science). *Aug. 2021 - Dec. 2025 (expected)*

- Control co-design and optimization of wave energy converters.
- Development of multidisciplinary design optimization framework and numerical solver for marine hydrodynamics
- Multi-objective optimization to achieve balanced trade-offs among competing system objectives.

Cornell University Ithaca, NY

Masters - Systems Engineering *Aug. 2021 - Dec. 2024*

- Multidisciplinary design optimization of novel offshore systems.

Winona State University Winona, MN

B.S, Data Science and Mathematics with dual concentrations: (Computer Science, Statistics) *Aug. 2016 – May 2020*

- Data science and data engineering foundations.

Research and Work Experience

R&D PhD Intern June 2024 – Aug2024

Adjoint based solver for marine hydrodynamics *Sandia National Laboratories, Albuquerque, NM*

- Developed a differentiable simulation method for hydrodynamics for differentiable control co-design optimization.
- Utilized reverse mode automatic differentiation implementation of boundary element method in Julia.

Data Analyst Jun 2020 – Jul 2021

Database Team *Fastenal Company, Winona, MN*

- Built pipelines to ingest data from multiple sources (database, excel files and csv) using R and Python packages like Pandas, PostgreSQL
- Utilized apache airflow to schedule and monitor data pipelines across different sales and customer segmentation analysis.
- Developed forecasting models (ARIMA) to predict demand and prices in supply chain.
- Applied advanced feature engineering techniques, including statistical and temporal transformations, to enhance ARIMA model performance.
- Summarized sales trends and insights into TABLEAU dashboards, and documentation in confluence.
- Created interpretable predictive models and validated results using time series based statistical tests.

Argonne Trainee July 2024 – Aug 2024

Argonne National Lab *Chicago, IL*

- HPC training for computational science and engineering
- CUDA programming in Julia for rapid training of neural networks and numerical simulations
- Large scale scientific visualization using Paraview, Ascent and VsIt
- Scientific software design principles and reproducibility through better software practices

Summer Internship June 2019 - August 2019

Statistics, Machine Learning *Carnegie Mellon University, PA*

- Combined network analysis based metrics with statistical models to build a network performance estimator.
- Developed a statistical model for pass chains outcome prediction using spatio-temporal data from soccer games.

Machine Learning Deployment: Minnesota Lake Quality

- Developed and deployed a REST API for batch predictions in a citizen science project analyzing water quality data of Minnesota lakes.
- Implemented a CI/CD pipeline for machine learning delivery using Heroku, enabling automatic detection of new data files and seamless integration of model updates.
- Designed a data pipeline to handle local data processing and integration with cloud storage services (e.g., Amazon S3).
- Collaborated with data from the Minnesota Department of Natural Resources (DNR) to integrate domain knowledge into the data preparation process.
- Gained hands-on experience delivering a complete data product from data collection to deployment

Relevant Courses

- Database management, Big data, Multidisciplinary Design Optimization (MDO, PDE constrained optimization), Data Visualization, Mathematical Modeling, Inverse Problems, Machine Learning, Statistical Modeling, Data Science at Scale, Advanced Mathematics, Principles of Data Science, Optimization (Convex, Linear, Integer, MILP, MINLP),

Publications and Conference Papers

- **Kapil Khanal**, Carlos A. Michelén Ströfer, Matthieu Ancellin, Maha Haji). Fully Differentiable Boundary Element Solver for Hydrodynamic Sensitivity Analysis of Wave-Structure Interactions, https://doi.org/10.1016/j.apor.2025.104707, Applied Ocean Research
- **Kapil Khanal**, Nate DeGoede, Maha N. Haji. Multidisciplinary Design Optimization of Wave Energy Converter Farms Considering Uncertainty through Polynomial Chaos Expansion. In preparation for *Renewable Energy*.
- **Khanal, Kapil** and DeGoede, Nate and Vitale, Olivia and Haji, Maha N., Multi-Objective Multidisciplinary Optimization of Wave Energy Converter Array Layout and Controls. Available at SSRN: https://ssrn.com/abstract=4891821 or http://dx.doi.org/10.2139/ssrn.4891821
- **Khanal, K.**, & Haji, M. N. (2025, Aug 12). Differentiable wave2wire : Gradient based control co-design method to optimize the wave energy converter systems, ASME-IDETC 2025
- **Khanal, K.**, & Haji, M. N. (2022, October 25). Multidisciplinary Design Optimization for Novel Offshore Systems. Presentation at the openMDAO Workshop, NASA Glenn Research Center, Cleveland, Ohio
- **Khanal, K.**, McCabe, R., & Haji, M. N. (2023). Gradient-Based Design Optimization of Concentric Cylindrical Offshore Structures. In Proceedings of the SIAM Conference on Optimization (OP23), May 31,Seattle. Washington
- **Khanal, K.**, Vitale, O., DeGoede, N., & Haji, M. (2023, October 4-6). Multi-objective Multidisciplinary Optimization of Wave Energy Converter Array Configurations and Controls. Presented at the University Marine Energy Research Community 2023 Conference, Durham, NH, USA
- Lalisani, S., Diaz, I., Chan, H., **Khanal, K.**, Haji, M., & Royer, F. (2026, January 12). Multidisciplinary Design Optimization of Shape Programmable Space Structures. AIAA SciTech Forum 2026, Session MDO-02/STR-03: Structural and Topology Optimization Applications for Air and Space I, Washington, D.C.
- Open-source toolbox for semi-analytical hydrodynamic coefficients via the matched eigenfunction expansion method, McCabe Rebecca, **Khanal Kapil**, Haji Maha, UMERC Conference, Aug 7, Duluth, Minnesota

Professional Associations

American Statistical Association, MinneAnalytics, INCOSE, Society of Industrial and Applied Mathematics (SIAM).

Community Data Projects

- Budget Expenditure Dashboard, Winona Area Public Schools Data Extraction from scanned pdf's and a detail visualization of budget and expenditure data to help them prioritize the budget spending for schools.
- Deploy Dashboard for quick access to citizen scientists. Built a dashboard for Aeon Housing-Non-profit organization. Exploratory analysis on experience of tenants on Aeon's affordable houses.

Technical Skills

Programming Languages

Python(8+ years), R(8+ years), SQL (8+ years); Julia (5+ years)

Tools and Platforms

Snowflake, AWS, Databricks, Heroku, CI/CD, Apache Airflow, Prefect, MLFlow, Gurobi, PySpark

Honors, Awards and Grants

AWS compute credits award Feb 2023, 2024

- Awarded compute credits worth $15k for computational simulations and machine learning.

Seedling Grant (Phase I & II), Sandia National Laboratories Feb 2023, 2024

- Seedling grant to develop a differentiable BEM numerical method for systems engineering applications.

Systems Graduate Fellowship Aug 2022

- Awarded a graduate fellowship by the Systems Department, Cornell University.

Outstanding Student Award May 2020

- Received an Outstanding Student Award from the WSU Mathematics and Statistics department.
- Recipient of the Presidential Honor Scholarship for high academic achievement.
- MinneAnalytics Scholarship recipient for extensive contributions to the broader analytics community in the Midwest.

MUDAC-Data Analytics competition Aug 2018

- Presented a report on Diabetes and insurance Cost with the prediction of healthcare cost for each anonymized patient, using Python and R libraries and Tableau extensively.

Best Overall Analysis, Police Data Challenge (ASA) Dec 2017

- Participated in a nationwide (USA and Canada) competition organized by the American Statistical Association.
- Presented a dashboard and analysis report on the pattern of 911 calls in Seattle to a panel of statisticians and criminal justice reform professionals.

Conferences presentations

University Marine Energy Conference, Durham NH Oct 2023

- Presented methods and framework on optimizing layout and dimensions of WECs together.

SIAM Optimization Conference, Seattle WA May 2023

- Chaired the session on numerous applications of different kinds of optimization applications.
- Optimization of design concentric cylinders using differentiable semi-analytical matched eigenfunction method

OpenMDAO Conference, NASA Glenn Research Center, Cleveland Ohio Oct 2022

- Performed the coupling of the BEM (Boundary element method) solvers within openMDAO optimization framework.

Midwest Data Science Conference, Optum, MN Oct 2018, 2019

- Presented on the prediction of healthcare cost using RandomForest and XGBoost algorithms.

Posters

- Presented a poster on the simulation of the migration of bats - WSU Research.
- Displayed a poster on network modeling of events data at Carnegie Mellon sports analytics conference.
- System Architecture for eVTOL-based Emergency Medical Services, Kapil Khanal, Danushka Edirimanna, Hins Hu

Teaching and Tutoring

- Multidisciplinary Design Optimization, Machine Learning, Data Structure, Object-Oriented Programming, Supervised Learning.