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Kelly Mathesius

kjmath.github.io/**portfolio**

SELECTED WORK EXPERIENCE

Formlabs – *Research and Development Engineer*   *June 2023 - Present*

- **Computational physics models for 3D printer design and optimization**: implemented a custom Reynolds-equation PDE solver to predict resin pressure/force on parts and enable force-constrained motion planning (up to 45% lower forces); developed a fluid–structure interaction model capturing coupled effects of printer stiffness, resin properties, and part motion to inform next-gen hardware selection; built an optical/fluid model to jointly optimize layer height and exposure, reducing print times by up to 20 minutes
- **Data pipelines for performance analysis and prediction:** built SQL/Python pipelines for print metrics and metadata with automated data-quality validation; applied hypothesis testing and regression models; built dashboards/visuals in Python and Grafana; used insights to predict next-gen printer performance
- **Experimental design and data collection for print reliability and speedups**: defined success metrics and designed structured parameter sweeps; collected and validated datasets; analyzed results to quantify trade-offs
- Managed and mentored interns; built documentation for stakeholders; presented findings to upper management

MIT International Center for Air Transportation – *Graduate Researcher*   *Sept 2017 – June 2023*

- **Differentiable models and gradient-based design optimization:** Developed an end-to-end differentiable model in Python for gradient-based optimization of rocket motors with constraints on exhaust plume radiant emission; used model to optimize the design of a small, fast flight vehicle, reducing peak radiant emission by 29% while only reducing motor specific impulse by 0.5%
- **Experimental design and data analysis for model validation:** Designed and conducted experiments to measure the effects of solid rocket motor design parameters on exhaust plume radiant emission; built an end-to-end analysis pipeline to extract, filter, validate, and analyze motor data; used results to validate and refine the modeling approach

Blue Origin – *Engines Materials and Processes Intern*   *June - August 2019*

- Identified, mixed, and characterized alternative extrude honing media for improving interior surface finish of cast or additively manufactured metal engine components
- Designed and built a test rig for evaluating extrude honing media; tested effectiveness of developed media at improving surface finish of test coupons

SELECTED PUBLICATIONS

End-to-End Differentiable Model for Optimization of Rocket-Powered Vehicles Including Plume Radiant Emission.
   K. J. Mathesius, P. D. Sharpe, and R. J. Hansman. AIAA JSR, 62(3), 2025 [pdf]
Experimental Study of Low-Thrust, End-Burning Solid Rocket Motors Including Plume Radiant Emission.
   K. J. Mathesius, M. E. Knotts, M. T. Vernacchia, and R. J. Hansman. AIAA JSR, 62(2), 2025 [pdf]
Integrated Design of Solid Rocket Powered Vehicles Including Exhaust Plume Radiant Emission**.**
   K. J. Mathesius. PhD Thesis, Massachusetts Institute of Technology, 2023 [link]

EDUCATION

Massachusetts Institute of Technology   *Cambridge, MA*

Doctor of Philosophy in Space Propulsion (Aerospace Engineering)   *Sept 2019 - June 2023*
- Key classes: matrix methods in data analysis and machine learning, numerical methods, statistics, rocket propulsion

Master of Science in Aeronautics and Astronautics   *Sept 2017 - June 2019*
Bachelor of Science in Aerospace Engineering   *Sept 2013 - June 2017*

SKILLS

Python (NumPy, pandas, scikit-learn, statsmodels), developer tooling (Git, CI/CD), virtual environments (uv/poetry), SQL (BigQuery), visualization (Grafana, matplotlib, seaborn), optimization (CasADi, AeroSandbox)