Efe Eroz

CURRICULUM VITAE

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EDUCATION

Stanford University **Sep. 2026 – Present**
Mechanical Engineering PhD Student. *Stanford, CA*
PhD funding from the National Science Foundation’s GRFP Fellowship Program.

Princeton University **Sep. 2022 – May 2026**
Deg. Programs: Mechanical Eng., Aerospace Eng. – Minor: Computer Science. *Princeton, NJ*

GPA: 3.95. Graduated with highest honors (summa cum laude). Elected to Phi Beta Kappa, Tau Beta Pi, & Sigma Xi societies. Received Princeton Shapiro Prize for Academic Excellence.

- APC523: Numerical Algorithms
- MAT203: Adv. Multivariable Calc.
- MAT204: Adv. Linear Algebra
- MAE305: Differential Equations
- COS226: Algorithms/Data Struct.
- COS324: Intro ML (A+, 1st of 146)
- COS323: Computing & Optimization
- COS487: Theory of Computation
- MAE221: Thermodynamics
- MAE223: Solid Mechanics (A+)
- MAE222: Fluid Mechanics (A+)
- MAE335: Fluid Dynamics (A+)
- MAE423: Heat Transfer (A+)
- MAE427: Energy Conversion (A+)
- MAE433: Automatic Control Systems
- MAE331/2: Aircraft Dyn. & Design
- MAE206: Intro Eng. Dynamics (A+)
- CEE312: Statics of Structures (A+)
- MAE321: Engineering Design
- PHY104: Elec./Magnetism (A+)
- PHY105: Adv. Mechanics

RESEARCH EXPERIENCES

Research Rotation: Data-Based SGS Modeling | *w. Prof. Sanjiva K. Lele (Stanford ME)* **09/2026 – Now**

- Using data from detailed simulations of compressible homogeneous isotropic turbulence (CHIT), we aim to develop neural network-based models for predicting subgrid-scale (SGS) phenomena to allow for efficient simulation of these flows within the Large Eddy Simulation (LES) framework. This work will include an *a priori* evaluation of the data-driven models’ predictions with ground truth data from the detailed simulations.
- Funding support from NSF Graduate Research Fellowship Program (GRFP).

Optimal Combustion Mixing Models | *w. Prof. Michael E. Mueller (Princeton MAE)* **06/2024 – 05/2026**

- **Description:**
  - In the context of many-fluid stream, turbulent combustion simulation, making assumptions about how the fluid streams mix with one another is valuable because such assumptions **reduce the dimensionality** of the governing equations. This makes the equations **less computationally taxing** to solve.
  - However, current state-of-the-art mixing frameworks are derived with **unrealistic asymptotic (limit-case) mixing assumptions** (e.g., infinitely fast mixing of some fluid streams pre-combustion).
  - Recognizing this limitation, I constructed a novel family of mixing models that relaxes the need to make these asymptotic assumptions. Over the course of many months, I also derived an **on-the-fly simulation strategy** that dynamically identifies the provably-optimal mixing model in each region of a flame.
  - This strategy improved mixing descriptions in some regions of our test flame configuration **100-fold.**
- **Selected Applications:** Enabling rapid design iteration for *1) aviation gas turbines* with multiple fuel inlets or that use staged combustion like rich burn-quick mix-lean burn (RQL) to reduce emissions, and *2) automobile engine* strategies like reactivity-controlled compression ignition (RCCI) or exhaust gas recirculation (EGR).
- **Skills:** Regular use of Python & Bash (Linux CLI); simulations were Fortran-based (used Slurm on Princeton’s Tiger3 cluster). Learned distributed version control with Git and typesetting with LaTeX.
- **Research communication (external links):**
  - Princeton senior thesis: *thesis link.*
  - Conference talk, 14th U.S. Nat’l Combustion Meeting (USNCM), Boston (March, 2025): *1st-author paper.*
  - *Conference talk, 78th APS Dep. of Fluid Dynamics (DFD)* conference, Houston (Nov. 2025).
  - Selected (old) GitHub repos, mainly for data analysis/visualization: *Repo 1 (general simulation analysis), Repo 2 (optimal model generalization).* Main algorithm implementation is in group code (not included).

Research Internship: Combustion Non-Monotonicities | *w. Prof. Michael E. Mueller (MAE)* **Summer ‘23**

- I analyzed **pollutant formation dynamics** for multicomponent fuels, finding nonlinear (and even non-monotonic) trends in pollutant formation in response to linear changes in fuel composition.

- Specifically, a blend of fuels may produce **15% less/more** normalized emissions than either fuel alone.
- **Example Application:** Emissions predictions when blending sustainable aviation fuel with traditional jet fuel.
- **Skills:** Regular use of Python & Bash for data analysis and visualization; the simulations were Fortran-based.

Research Internship: Telecommunications | *w. Prof. Tolga Duman (Bilkent EE Dept.)* **Summer '21**

- When transmitting information (codewords), controlled redundancy is often added to the transmitted message in a manner known to both the transmitter and receiver to account for the potential presence of noise.
- I developed an algorithm to empirically calculate probabilities of confusion between each pair of codewords, then greedily update the codewords based on these probabilities. This **incrementally improves** the codeword set.
- This simulation-driven strategy is applicable to any arbitrary channel. Its performance **matched that of benchmark codes** over an additive white Gaussian noise (AWGN) channel as well as a more complex channel.
- **Research poster:** *poster link.*
- **Selected Honors & Awards (Telecommunications Research Internship):**
  - 2nd in nation among Engineering and Technology posters at DoD's 4-day invitational National Junior Science & Humanities Symp. (JSHS) conference in Albuquerque, NM (trip expenses paid by DoD)
  - Top 300 in nation: Regeneron STS Scholar (semifinalist). Included $2,000 prize for school.
  - American Institute of Aerodynamics & Astronautics (AIAA) YPSE Research Conference, High School Division: Honorable Mention (i.e., 2nd)

SELECTED HONORS & AWARDS

- National Science Foundation Graduate Research Fellowship Program (NSF GRFP) Fellow
- Princeton Shapiro Prize for Academic Excellence (AY 23-24): Awarded to top ∼4% of Princeton class of 1,500
- Phi Beta Kappa Honor Society: Oldest nat'l honorary scholastic society; top 1/10 of Princeton seniors elected
- Tau Beta Pi Engineering Honor Society: Awarded to top 1/8 of Princeton juniors in engineering majors
- Sigma Xi Associate Membership: Elected based on "promise of marked achievement in scientific research"
- National awards for algorithm developed in telecommunications research internship (high school):
  - 2nd in nation among Engineering and Technology posters at DoD's 4-day invitational National Junior Science & Humanities Symp. (JSHS) conference in Albuquerque, NM (trip expenses paid by DoD)
  - Top 300 in nation: Regeneron STS Scholar (semifinalist). Included $2,000 prize for school.
  - American Institute of Aerodynamics & Astronautics (AIAA) YPSE Research Conference, High School Division: Honorable Mention (i.e., 2nd)
- 4-time American Invitational Math Exam (AIME) qualifier: Scored 8 (top 0.7% of MAA participants)
- USA Physics Olympiad (USAPhO) Qualifier (in the top ∼400 F=ma contest scores)

TEACHING, OUTREACH, & OTHER EXTRACURRICULARS

- Princeton Undergraduate Research Journal (PURJ): Managing Editor of Peer Review for STEM Papers
  - PURJ is Princeton's **first peer-reviewed undergrad journal.** It focuses on communicating diverse research work carried out by undergraduates using non-specialist, accessible language.
  - As **Managing Editor of Peer Review for STEM Papers,** I helped coordinate a board of >**30 undergrads and faculty,** pairing manuscripts with student/faculty reviewers, peer reviewing, selecting final manuscripts to be published, and helping authors improve their work. *Spring '24 Issue.*
- Princeton Rocketry IREC Team Avionics and Princeton High Power Rocketry Team
  - Helped design **solid-fuel rocket to reach 30,000 ft.** with CubeSat payload (launched in Midland, Texas). Proposed an air brake control algorithm to avoid overshooting target altitude.
- Princeton University Engineers without Borders Ecuador Team
  - Helped to plan a water well in a **550-person village in Ecuador** previously relying on water tank trucks delivering untreated water that contributed to waterborne illness.
- Princeton Robotics Team (Drone Subteam) and Princeton Engineering Council Vice Publicity Chair
- Teaching: gave free, online math courses to interested students nationwide (probability theory, number theory).
  - With the transition to virtual learning due to the pandemic, I noticed many younger students (like my younger brother) had limited instructional time. To do my small part to help out, I taught free basic math courses every week on probability theory and number theory to dozens of students nationwide via Zoom.
- Teaching: volunteered at Princeton SPLASH program for high schoolers, teaching introductory fluid mechanics.
  - I taught **free, applications-focused introductory fluid mechanics mini courses** to local high schoolers, discussing governing relations in a conceptual way as well as fun everyday applications: e.g., the so-called Magnus effect describing why curveballs curve in sports.

- Volunteered for more than 400 hours, including: food pantry for 5 years and volunteer assistant sports coach.
- Community Living Advisor (CLA) for 90-100 students/year at Princeton during my junior and senior year.
  - I fostered an inclusive community for students by holding regular study breaks, connecting students with University resources, and upholding community standards. Managed yearly activity budget of $1,000.
  - **I balanced this part-time job with research, courses, and engineering clubs.**
- Princeton Beekeeping, Princeton Garden Project, and Princeton Ultimate Frisbee Team.

SELECTED COURSEWORK & PROJECTS

- **Complete Conceptual Design of Long-Range Aircraft:** Design of a long-range, mid-size (170 passenger) aircraft with `OpenVSP` software. MAE332 mid-semester assignment.
- **Group Design of Unmanned Aerial Vehicle (UAV):** Group designed, simulated, and built 3-foot aircraft capable of 100 mph flight at 11,000 ft. intended for disaster relief. MAE332 Group Project.
- **Brief Linearized Stability Analysis of Aircraft:** Linearizing the differential equations governing an aircraft's motion about an equilibrium state (in particular, steady, wings-level flight) allows for a decoupling of the longitudinal and lateral motions assuming the perturbations are sufficiently small. Using the eigenvectors of the corresponding state space matrices as initial conditions reveals well-known flight modes that are analyzed and tied back into flight control and safety. MAE331 assignment.
- **Static Longitudinal Stability Analysis of Aircraft:** After deriving criteria for static longitudinal stability from first principles reasoning, `VSPAero`'s vortex lattice and panel methods are used to assess the stability of the Macchi MB339 aircraft. MAE331 assignment.
- **API-Based Weather Software:** Pulls and interactively graphs short-term data for any location.

SOFTWARE & MISCELLANEOUS

- **Software:** Python, Java, MATLAB, Bash (Linux CLI), Fortran, distributed version control with Git, LaTeX typesetting, Lisp, Creo & Autodesk, Minitab (statistics), computing cluster use (workload managed by Slurm).
- **Languages:** English (native), Spanish (intermediate), Turkish (intermediate).
- **Princeton Research Funding/Computational Resources Support:** Andlinger Center for Energy and the Environment (ACEE); Office of Undergraduate Research (OUR); Princeton Research Computing.
- **Citizenship:** US Citizen.