CASE WESTERN RESERVE UNIVERSITY EST. 1826

How to apply for the NSF Graduate Research Fellowship

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PhD candidate, Mechanical Engineering
2010 NSF GRFP Fellow

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First: who is this guy?

- Aerospace engineering undergrad at CWRU
- BS/MS in aerospace
- Now PhD candidate in mechanical engineering
  - Working on developing new methods to integrate detailed, accurate chemistry into large-scale simulations of reacting flows
- 2010 NSF GRFP and 2009 NDSEG Fellow

What is it?

- Three years of support
  - $30K stipend (maybe $32K next year?)
  - $10,500 for tuition and fees
- Can defer two years
- Around 2,000 fellows each year

Why do I want it?

- $$$
- Research independence
  - They are funding **you**, not a project
  - Just look at my situation!
- Prestige—looks great on CV

Who got it?

- >30 Nobel Prize winners
- >440 members of National Academy of Sciences
- U.S. Energy Secretary Steven Chu
- Google founder Sergey Brin
- *Freakonomics* co-author Steven Levitt
- Me
- ...You?

Who can get it?

- US citizen, national, or permanent resident
- Can't have received it already (duh)
- Can't have graduate degree by Aug. 1 (except BS/MS)
- Can't work for NSF
- Can't be in professional degree program (e.g., MD, JD, dental, public health), business administration/management, social work, eduction (except sci/eng), or history (exept sci/eng)
- Must be able to begin graduate study by Fall 2013

Who can get it? (cont.)

- Supported fields:
  - Chemistry
  - Computer & information science/ engineering
  - Engineering
  - Geosciences
  - Life sciences
  - Materials research
  - Math
  - Physics & astronomy
  - Psychology (some)
  - Social sciences (some)
  - STEM education & learning research

When can I apply?

- You can apply **three** times:
  - Senior year of undergrad, or after graduating but before grad school
  - First year of grad school
  - Second year of grad school, before completing fall term (≤ 12 months of full-time or ≤24 semester hours of part-time grad study by Aug. 1)
- Some exceptions for extenuating circumstances

How to apply

- Application is at Fastlane: www.fastlane.nsf.gov/grfp/
- Engineering deadline: November 8 @ 8 pm EST
- References deadline: November 13 @ 8 pm EST
- Timeline:

July	Nov	Jan	May
Work on essays Contact references	Submit!	Troll The GradCafe forums	Winners announced

The application

- Three **two-page** essays
  - Personal
  - Research experience
  - Research proposal
- Three references (you can request five)
  - They submit for you, but you have to make sure they do!

Personal essay

- Why are you getting a PhD?
- Describe **experiences** that contributed to your preparation and desire to pursue advanced study
- Describe **leadership potential** and how you'll **contribute** to research, education, & innovation
- Talk about career **aspirations** and **goals**
- Purpose is to demonstrate your **potential**

Research experience essay

- Describe any research activities
  - Undergrad research
  - Research in summer/part-time job
  - Work study
  - Separate undergrad and grad research
- Explain purpose and your role, and what you learned
- Did you present or publish? List any
- If none, talk about what prepared you for research

Research proposal (1)

- Present complete plan for **original** research project
- Demonstrate **understanding** of research design & methodology
  - Explain relationship to previous research (if any)
  - Short list of citations at end
- Present problem to solve or unanswered question
  - Address “why is this important?”

Research proposal (2)

- Needs to be **original, new, and significant.**
- Not too many citations, but need to have performed good literature review
- Talked to your advisor
- Can add separate “Broader impacts” section (with label)
  - Makes reviewers’ jobs easier...

How am I judged?

- Two main criteria (same as NSF grants):
  - Intellectual merit
  - Broader impacts
- Reviewed by panel of scientists & engineers in your discipline
  - Professors, national lab scientists, industrial researchers
- Seniors evaluated **separately** from grad students

Intellectual merit

- How important is proposed activity to **advancing knowledge & understanding?**
- How **well qualified** is proposer for project?
  - Your academic record: grades, GRE scores
- Does proposed activity suggest/explore **creative, original, or potentially transformative concepts?**
- How well **conceived & organized** are proposed activities?
- Sufficient access to resources (computers, equipment)?

Broader impacts (1)

- How well does activity advance discovery & understanding while promoting teaching, training, & learning?
- How well does activity broaden participation of underrepresented groups?
- To what extent will it enhance infrastructure for research & education?
- Will results be disseminated broadly?
  - Conferences, publications, open data
- **Benefits to society?**

Broader impacts (2)

- Your research proposal will likely only address "benefits to society".
- **This is not enough!**
- Your other essays **need to address** other catagories
  - Volunteering
  - STEM outreach
  - If you don't have anything, get involved now!

Kyle's experience

- First try: 2008
  - Honorable Mention
  - Intellectual Merit: all "excellent"
  - Broader Impact: "good", "very good", "good"
    - Comment: "It is not clear to me how he will involve K-12 activities in his research"...
- Second try: 2009
  - Fellow
  - What did I do differently?

Honorable Mention vs. Fellow (1)

- Previous research
  - One submitted journal paper, two conference papers
- Research proposal
  - Added some planning words (“First”, “Second”)
  - Added reference to my journal paper
- Personal Statement
  - **Added paragraph describing involvement with middle school STEM outreach event**

Honorable Mention vs. Fellow (2)

great opportunity to leverage my strengths in teaching and helping others understand concepts as a teaching assistant for the Advanced Engineering Mathematics and Aerostructures courses.

Research, discovering new ideas and new ways of doing things, presented me with a way to demonstrate my problem solving skills. I first worked in the area of bone mechanics and image processing where I was able to solve multiple issues that had previously plagued the researchers in the project such as image alignment and segmentation for three-dimensional rendering, but I realized the perfect match for my interests when fluid dynamics and combustion modeling were exposed to me. I approached Professor Chih-Jen Sung of the Combustion Diagnostics Laboratory to work on my master's degree research and he has provided me the opportunity to pursue my Ph.D. During a summer internship at NASA Glenn Research Center, I learned how to use new computational fluid dynamics software and model the desired objective, a cryogenic propellant storage tank, in a novel manner. I started my master's research this semester when I took over a project developing a chemical reaction mechanism reduction package for combustion modeling and I am currently working to solve the problems left from prior work.

I aspire to a career in engineering research because I want to make a difference in the world. I believe that the future of energy lies in renewable sources but research currently needs to focus on improving and upgrading current combustion-based technology in addition to developing those sources. I am interested in combustion modeling not only because the subject is fascinating but also because it is used in the energy and transportation industries to improve combustor and engine designs for higher efficiency and lower emissions. These two goals lower the environmental impact of combustion-based technology and allow more responsible use of such devices. In addition, the aerospace industry uses combustion modeling to design next-generation launch vehicles and aircraft to improve space access and atmospheric flight. Manned space exploration requires new and innovative space vehicle design starting with reliable engines. My research interests are not limited to combustion modeling, however; my future research interests also branch into adaptive combustion control for smart and fuel-flexible engines and combustors as well as the coupling between fluid dynamics and combustion in reacting flows. My interest in modeling also extends to other types of reacting flow modeling applications such as fuel cells, hydrogen generation, biofuel generation, and even the dynamic modeling of the sun and stars (where nuclear reactions occur in addition to chemical reactions).

In short, I am pursuing advanced study in aerospace engineering because I want to contribute to society with my research and help stimulate the interests of students in science and engineering. Through teaching I hope to spread my excitement about engineering to others at the university and public levels. As a researcher, I aim to innovate in advanced combustion system design through modeling to decrease the environmental impact of such technology. The NSF Graduate Student Fellowship will allow me to pursue this goal starting with my doctoral studies, ensuring that my days continue to be perpetual mornings.

opportunities to leverage my strengths in teaching and helping others understand concepts as a teaching assistant for the Aerostructures course in spring 2008 and for the Advanced Engineering Mathematics course in fall 2007 and 2009. Since I took these specific classes as an undergraduate, I have a unique perspective and ability to assist the students.

Research, discovering new ideas and new ways of doing things, presented me with a way to demonstrate my problem solving skills. I first worked in the area of bone mechanics and image processing where I was able to solve multiple issues that had previously plagued the researchers in the project such as image alignment and segmentation for three-dimensional rendering, but I realized the perfect match for my interests when fluid dynamics and combustion modeling were exposed to me. I approached Professor Chih-Jen Sung of the Combustion Diagnostics Laboratory to work on my master's degree research and he has provided me the opportunity to pursue my Ph.D. During a summer internship at NASA Glenn Research Center, I learned how to use new computational fluid dynamics software and model the desired objective, a cryogenic propellant storage tank, in a novel manner. I worked on my master's research the past year after I took over a project developing a chemical reaction mechanism reduction package for combustion modeling and I am currently solving the problems left from prior work.

I aspire to a career in engineering research because I want to make a difference in the world. I believe that the future of energy lies in renewable sources but research currently needs to focus on improving and upgrading current combustion-based technology in addition to developing those sources. I am interested in combustion modeling not only because the subject is difficult and fascinating but also because it is used in the energy and transportation industries to improve combustor and engine designs for higher efficiency and lower emissions. These two goals lower the environmental impact of combustion-based technology and allow more responsible use of such devices. In addition, the aerospace industry uses combustion modeling to design next-generation launch vehicles and aircraft to improve space access and atmospheric flight. Manned space exploration requires new and innovative space vehicle design starting with reliable engines. Through modeling, new concepts can be investigated that are beyond the reach of traditional techniques. Beyond mechanism reduction and modeling, my future research interests also branch into adaptive combustion control for smart and fuel-flexible engines and combustors as well as the coupling between fluid dynamics and combustion in reacting flows.

I recently assisted Professor Chris Hernandez, one of my undergraduate mentors, with a STEM outreach event called *The Many Faces of STEM*. This annual workshop brought about 50 7th and 8th graders from local Cleveland public schools to Case Western Reserve with the goal of exposing underrepresented students to science and engineering topics from faculty and undergraduate/graduate students. I helped plan and execute an interactive educational experiment as well as a brief demonstration of some mechanical engineering topics such as materials testing and robotics. Next year, I plan on integrating my research with a visual interactive program to demonstrate simple concepts in combustion. I hope to excite students at an age when I first became interested in science and engineering.

In short, I am pursuing advanced study in aerospace engineering because I want to contribute to society with my research and help stimulate the interests of students in science and engineering. Through teaching I hope to spread my excitement about engineering to others at the university and public levels. As a researcher, I aim to innovate in advanced combustion system design through modeling to decrease the environmental impact of such technology. The NSF Graduate Student Fellowship will allow me to pursue this goal starting with my doctoral studies, ensuring that my days continue to be perpetual mornings.

General advice

- Writing: no grammar, spelling, punctuation mistakes!
  - Remove “very”, “pretty”, “actually”
  - Active voice makes it interesting!
- Use all elements to tell whole story—don’t repeat
- **Pick a good advisor**
- Get someone to read (and critique) your essays
- Don’t wait until the last minute, FastLane will crash.
- Start now!

Another option: NDSEG

- Unlike GRFP, depends on content of research
  - Should be defense related somehow
- Three years, $30,500–$31,500 stipend + full tuition + health insurance
  - Same research independence
- ~200 fellows each year, 10% of applicants

NDSEG (1)

- Deadline: December 14, 2012 @ 5 pm EST
- Must be US citizen or national
- Either senior, or completed less than two years of full-time graduate study

NDSEG (2)

- Fields (more restrictive):
  - Aeronautical & astronautical engineering
  - Biosciences
  - Chemical engineering
  - Chemistry
  - Civil engineering
  - Computer & computational sciences
  - Electrical engineering
  - Geosciences
  - Materials science & engineering
  - Mathematics
  - Mechanical engineering
  - Naval architecture & ocean engineering
  - Oceanography
  - Physics

NDSEG (3)

- Application:
  - GRE scores, transcripts, etc.
  - Three references
  - **One essay**: summary of goals
    - <3,000 characters
    - Describe kinds of research, specific research questions that interest you, how your research might interest DoD, and your long-term goals

NSF GRFP vs NDSEG

- NDSEG stipend is higher (although according to GRFP website that might change next year)
- NDSEG pays for health insurance
- NDSEG application is easier/shorter
- GFRP doesn't really care about content of research
- **Apply to both!**

Questions?

- Contact me: niemeyer@case.edu