SUPERSONIC FLOW RESEARCH

Getting a doctorate degree in the United States of America

Universities offer a unique platform to perform world class research. Most of this work is actually done by doctoral students who become experts in their research fields while supervised by their academic advisors. And so, the PhD program is an outstanding opportunity to propel an engineer into becoming a first class scientist. I took on the challenge of obtaining a PhD, and now, three years into my adventure at The University of Texas at Austin, I realize it is the best career choice I have made. Let me give you a glimpse into the world of doctorate level research.

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SUPERSONIC FLOW RESEARCH

In 2007, while still a Master’s student in the Aerodynamics chair at Delft, I was part of a group that interned at Lockheed Martin Aeronautics in Fort Worth, Texas. It was more of a rule than an exception to use three day weekends for road trips to visit cities all over the States. That was a great opportunity to become acclimated to the US, other than being a tourist, and to experience Southern hospitality. All of this attracted me.

A few weeks after my internship, I arranged a four-month research project at Imperial College London on the honors track. This was a perfect chance to work with respected international researchers. Shortly after, while still being amazed by the opportunities available to me, I decided to arrange an exchange project for my Master’s thesis research. I came across a position at The University of Texas at Austin (UT). After an intense application process I ended up spending nine months at UT working on my thesis research. During that time, my co-supervisor, Dr. Charles Tinney, offered me a PhD research position, which I graciously accepted. In short, I learned why one should not only create opportunities, but aggressively pursue those which would otherwise pass by a lackadilical student.

THE PHD PROGRAM

Most non-US students are unaware that the PhD programs in the US extend far beyond research. When entering the program with a Master’s degree, one is still required to take additional advanced classes after admission into the program. After having already completed an extensive amount of course work at Delft, it felt very strange to sit in classes again. Nonetheless, it kept me sharp, refreshed my knowledge, and prepared me for the ‘qualifying exams’ (written and oral). Passing these exams is one of the most difficult requirements one must endure to be eligible for a PhD degree. A teaching assistantship is also common and this opportunity provides the student interaction necessary when one knows their future includes pursuing a career in academics. Lastly, the research that is performed, in parallel to the coursework, eventually results in your dissertation and defense. You most definitely have to be hard working and passionate about your choice of degree, as some Professors describe this period as “a constant fight against yourself”. This hard work is balanced by feelings of self-confidence and academic recognition or rewards.

SUPERSONIC JET NOISE

With my academic advisor having started his tenure track appointment during my first year in Austin, I was exposed to many research projects that I dug into as his first student. A new multidisciplinary fluid dynamics facility was designed by his group which includes an open-jet, open-circuit wind tunnel enclosed within an anechoic (echo-free) chamber. One of my responsibilities was to design and build a modular test rig within this chamber that would facilitate high-speed flow research. I find it immensely rewarding to be in charge of a project that involves hands-on work (designing and fabricating various hardware components) as well as developing analytical architectures to control jet rig conditions and to communicate to various laboratory instruments. While performing all of these tasks we began working with the National Center for Physical Acoustics (The University of Mississippi) on the aero-
acoustic aspects of supersonic jets. This prompted us to perform a recent study in our facility on a Mach 3 jet. The prominent sound from jet engines emanates from the turbulent mixing region downstream from the nozzle exit and undergoes complicated interactions while propagating to the far-field. Part of these findings were presented at a recent conference (Baars et al. 2012a) and is now being prepared for journal submission.

SHOCK WAVE RESEARCH
The main focus of my PhD dissertation research is on shock wave boundary layer interaction (SBLI). A few examples of by-products of the interaction between a shock wave and boundary layer are: flow unsteadiness and possible shock-induced separation, airframe panel resonance associated with buffeting, and localized heating due to an increase in heat transfer. This research is currently being sponsored by the Air Force Office of Scientific Research (AFOSR) and is of practical interest to high-speed transport (supersonic and hypersonic). In particular, we aim to characterize transient SBLI in a conical geometry with relevance to conically expanded rocket nozzles (figure 2 and 3). For instance, any asymmetry in the shock location can cause excessive static and dynamic loads on the structure; a recent journal publication describing these phenomena was written in collaboration with colleagues at NASA Marshall Space Flight Center (Baars et al. 2012b).

COMMUNICATING RESEARCH
One of the greatest aspects of doctoral research is being able to communicate your findings to collaborators, the broader aerospace community, funding agencies, and enthusiasts alike. You can keep yourself quite busy in the lab, but to make an impact and to show the necessity of the research this step is crucial. Additionally, conferences and publications are great to get your name out there. After attending just a few of these conferences I was surprised by the network of people created around my research topic. Furthermore, one can make an impact as to where the research should head and this makes you realize the influence you can have, when being in the initial stage of an academic career.

BEING AN AUSTINITE
The capital city of Texas quickly takes away the stereotypes that Texas is full of cowboys, dusty streets, and gun sweeping Sheriffs. The city is located on the banks of the Colorado River in central Texas and it is apparent that the outdoor and city life meet in Austin. There is an active downtown area with the campus located just north of that, but I often escape the city and find myself mountain biking in the rural areas just half an hour away. Austin's population is 650,000 within the city limits and UT has slightly over 50,000 students from all disciplines. Just a few keywords to describe Austin are: young, growing, active, outdoorsy, and innovative. A variety of high-tech companies are also located in the surrounding 'Silicon Hills' and the city is in close proximity to the metropolitan areas of Dallas/Fort Worth and Houston. As a balance to the professional life, high-quality free time includes eating BBQ, exploring the roof top bars downtown, outdoor trips, and waterskiling on the nearby lake. These are just a few examples of mind-clearing activities you can do here. On top of that, 'The Live Music Capital of the World' is also home to the South by South West festival in the Spring and Austin City Limits in the Fall. Although biased towards Texas when it comes to living, I had the opportunity to see about twenty states and I can truly say that this state is fantastic.

FUTURE PLANS
Right now, I have about one year left in my PhD program. I'm leaning towards obtaining an academic position. I highly encourage students to take on any of the international opportunities that pass by. Delft Aerospace is like a trampoline; you can always bounce back on the foundation of knowledge and kick yourself to another level.

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References


Research Group Website: http://www.ae.utexas.edu/facultysites/tinney