

# DAAD-RISE Summer Research Opportunity Report

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30 September 2009

My experience in Germany this summer was extremely gratifying. In addition to conducting research in Hamburg, I was able to complete a two-week language course in Berlin and attend a conference in Heidelberg. I would like to express my gratitude to DAAD for providing me with this once-in-a-lifetime opportunity.

**Germany** While in Germany, I was able to stay in several cities, including Hamburg, Berlin, and Heidelberg. I was also able to visit Munich, Nuernberg, Dresden, and even Salzburg thanks to the railticket kindly provided to me by DAAD. I found Germany to be a very safe and clean country with a high living standard and many enjoyable historical sites.

After leaving the US, I first arrived in Berlin for two weeks to attend the language course. Right from the start, I was really pleased with the relaxed feeling that struck me. All the people I met, from my hostess to the people at the language institute to even total strangers, were very friendly and helpful.

The language course allowed me to significantly improve my spoken German and prepared me to start my research project. I truly enjoyed my stay in Berlin. Every corner of the city was filled with a sense of history representative of the tumultuous 20th century.

I spent most of my time in Germany in the city of Hamburg. Soon after arriving, I noticed how different it was from Berlin. Because I was able to visit so many cities, I truly came to appreciate the great diversity that exists throughout Germany.

Hamburg was the perfect setting for my research experience. Its rich nightlife was a great way to relax after a day spent working in the laboratory. It also allowed me to form friendships with my colleagues (three RISE students, a US exchange student, and a number of German graduate students). The living conditions in my dormitory were excellent. There I met students from the Technical University of Hamburg and was able to make even more friends. I truly came to experience and enjoy the lifestyle of a student in Germany.

**Research Experience** In the Technical University of Hamburg I got to know first hand what research in Germany is like and how it differs from research in the USA. It also gave me the opportunity to work in an international team, something which is extremely valuable in today's globalized world.

Research supervision in the USA and in Germany are very different. In Germany, supervision is provided in a way that maximizes the amount of time students spend working *independently* on the project. As a result of this approach I familiarized myself with a very interesting and complicated subject area, developed my research skills, and learned new ones. Most importantly, I got to know what it is like being a PhD candidate in Mechanical Engineering, one of the options that I have been considering for my future.

My research project investigated squeaking in artificial hip replacements. Hip replacements are made of four parts - a ceramic ball attached to a titanium stem, and a ceramic hemisphere fit in a titanium liner. My research project focused on the influence of alternative materials on the parameters of the squeaking. The cause of this squeaking are the so-called friction-induced vibrations. I had to get acquainted with friction induced-vibrations, perform experiments, analyze, and report them.

Measurements were obtained with a laser vibrometer. I spent some time to investigate the software that it uses and its operational procedure. In addition, I independently set up another laser vibrometer, which we were able to secure for our research project. To analyze the discrete signal obtained from the vibrometer, I wrote a number of MATLAB programs, which were used to analyze the frequency spectrum of the signal. In this way I further improved my programming skills.

The summer before I came to Germany I worked at a theoretical research group at Yale University. The summer I spent in Germany allowed me to familiarize myself with experimental work and the difficulties of its planning, performance, and analysis. My adviser let me work through many of these difficulties on my own. During the discussions that we had, I was able to get his opinion and assess my progress with the project. I liked the fact that he considered me responsible enough to independently undertake steps on my research project and to handle expensive and fragile equipment. Independent work allowed me to stress the aspects that I considered important. In this way both my adviser and I benefited - he was able to get a different perspective on the project, and I was able to experience independent research, developed my experimental techniques, improved my attention to detail. To document my project, I used L<sup>A</sup>T<sub>E</sub>X, an extremely useful document preparation system, that I learned on my own.

The working atmosphere fostered productivity, ingenuity, and collaboration, which tremendously increased productivity. I got to realize that research is an process of creativity. To be able to apply non-standard thinking in order to come up with a good solution to a problem, a researcher should vary the atmosphere he/she is in.

**Opportunities in Germany** The RISE research internship allowed me to get acquainted with the great number of opportunities Germany offers. These include education, research, and work. Germany is a country with a long tradition in engineering and creating engineers. This is reflected in both company and university profiles. The educational system emphasizes connections between students and research companies. Students are required to find a company to work with for the completion of their theses. Similarly, PhD students often have their thesis research sponsored by companies.

The meeting in Heidelberg introduced the participants to a number of universities looking forward to accepting American students. Most of their programs do not require knowledge of German. During the conference we also got to know about the many opportunities available for financing study/research in Germany.

**Conclusions** For me, the summer of 2009 saw an incredible amount of improvement in all spheres: academic, professional, personal. The greatest benefits of the research experience were the development of new skills, working in an international setting, and acquainting myself with PhD research. It allowed me to make decisions about my future and to consider new options. I believe a summer internship abroad is a valuable opportunity any student from the USA should seriously consider, and DAAD-RISE is certainly among the best ones.

I agree that my report and accompanying pictures are used by the DAAD in printed materials, presentations, and on the website in order to inform funding organizations, sponsors, and students about the RISE program.