

Theresa Bickel

Graduation Year: Senior

College: Arts & Letters, Engineering

Major(s): Mechanical Engineering, Japanese

Minors(s): n/a

Scholar Group Membership: No

Did you received other funding for this project?: Liu Institute

Could you have completed this project without CUSE funding? No

More details on CUSE funding assistance?

Project Title: Timken Large Wind Bearing Online Monitoring System

Project Location: Tsinghua University, Beijing, China

ND Faculty Mentor: Bill Goodwine

Project Type: Research, Internship

Why did you undertake this project/experience? Career discernment and/or preparation, Internationalize your Notre Dame experience

Did your funded experience help you:

[Deepen your understanding of your coursework or field of study]: A Little

[Discern your interests and post-bac goals]: Yes

[Become confident in your ability to set and achieve your goals]: Yes

[Gain a more nuanced view of local, national, or global communities]: Very Much

[Improve your written and verbal communications skills]: Yes

Tell us about your experience.

For the past 7 weeks I have been working on a research project with a team of engineering students (one Notre Dame student, three Tsinghua students) at Tsinghua University in Beijing, China. Our task was to design an online monitoring system for the main bearing in a wind turbine. This required a lot of in-depth research about the various modes of bearing failure, bearing failure symptoms, failure detection, signal processing, and condition monitoring. The first few weeks were spent reading dissertations and research papers. There was so much information to sift through; each person was assigned a different topic to research. After collaborating our findings, we decided that Acoustic Emission offered the best solution to our problem (detecting failure via high-frequency sound waves). From the information we gathered, we began to form a general concept of the system we wanted to design. There was a variety of hardware and signal processing algorithms that we could use, so we split our team into two groups: one to work on hardware and the other on software. Engineering constraints were examined to narrow down the hardware options. After much brainstorming, a signal processing algorithm was developed to detect failure in a bearing. We now had most of our system solution. Unfortunately, we were not equipped to test the entire system. Instead, we designed two experiments we would conduct to make sure the system worked. However, we still wanted some sort of validation for our work. Our supervising company and professor provided us with

some equipment to acquire an experimental bearing signal we could process with our algorithm. Our software classified the bearing as healthy (which it was), so it works to that extent. Nearing the end of our project, and time in China, we consolidated all of our research, experiment proposals, and our solution into a written report. During the last week, we prepared a presentation summarizing our project and presented it to our company mentor, supervising professors, and the other project teams. While we did a fair amount of work, we also made time on the weekends visiting places of cultural/historical significance, such as the Forbidden City and the Great Wall, and getting to know our project partners.

Through this project, I learned about bearings, their failure mechanisms, and how engineers detect this failure. I also learned to ask for help as soon as possible if you run into a problem your team cannot work out alone. This project illustrated the importance of remote condition monitoring and how many factors you need to consider when designing anything (accuracy, reliability, durability, etc.). My research has given me some insight into the research done in the engineering industry. I certainly learned a lot about wind turbine bearings, but I also learned what life is like living and working in another country where the language and culture are completely foreign to you. It was truly a unique experience that taught me about communication and teamwork. By communication, I do not simply mean English versus Chinese, but presenting our thoughts and ideas in a way that both sides could understand and then determine a course of action. This entire project was a process in figuring out how to make our multinational collaboration efficient and productive.

Describe the impact this project had, both on you as a student-scholar and on the people you worked with.

My experience on this project has impacted the way I view teamwork, international collaboration, design, and the engineering industry. This project challenged the way I was comfortable operating as a student. In communicating and working with my Chinese teammates, I had to rethink the way I would explain an idea, propose a course of action, and request someone to complete a task. While our area of study provided common ground and we all strived towards the same goal, we also had different ideas about how to complete the project. I think that both parties had to make some concessions at some point.

As a student-scholar, this project reminded me to focus on the bigger picture. Sometimes I would find myself fixating on a portion of the design, neglecting how it fits into the whole solution. When presenting our design at any stage in the process, we needed to be thorough, detailed, and confident about our decisions. Every decision in the design requires justification so people can understand why you took the path you did.

This project impacted the way my teammates and I approached communicating and problem solving. Each of us had to take into consideration the best way to clearly convey something so everyone can understand. We worked to maximize each other's strengths and overcome challenges by helping each other.

Describe how this experience is connected to your plans as a student or future professional.

This research/internship experience contributed to the discernment of my future career. Though I am currently preparing to apply for jobs, I still am not sure what path I want to pursue. I am

