

RISE Germany Final Internship Report

Julian Nicolai, Summer 2023

Consent

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

Background

I participated in the DAAD RISE Germany exchange internship from June 6th to September 3rd in 2023. Coming from Canada, I received the Mitacs scholarship lumpsum of CAD \$6000 (approx. 4000€). I studied at the Hochschule München during my stay in Germany, for research into fibre optic sensing—a field I had previous experience with from my home institution of Carleton University in Ottawa.

Research

Background Knowledge

There exists a unique optical component called a fibre Bragg grating (FBG), which is written into a glass fibre optic cable using a UV excimer laser. When light is put down the fibre, a peak at a specific wavelength can be observed using a spectral analyser (i.e., a specific colour). By applying stresses to this fibre-embedded component through temperature or strain, this induces changes in its geometry. Through the spectral analyser this geometric change is seen as a peak moving across the spectrum (i.e., the colour changes). By tracking the location of this peak (the colour), you can thereby determine with remarkable precision the magnitude of this physical change (temperature or strain), which is by its nature, a sensor.

Project Concept

Our research focuses on using a specific variation of the FBG, a so-called π -shifted FBG (PSFBG). This novel approach involves partially coating the PSFBG with a thin composite layer of nickel and palladium through atomic layer deposition. When palladium metal is exposed to hydrogen, this hydrogen diffuses into the material. Analogous to a sponge, as the palladium absorbs the free hydrogen gas, it swells. This applies strain to the PSFBG sensor, the effect of which can be measured as a peak shift on the light spectrum. The higher the hydrogen concentration, the more strain on the sensor, the further the shift. The advantage of this device however, is that because the component is partially coated, this allows for temperature to be independently extracted, due to the unique spectral shape of the PSFBG spectrum. In summation, this presents a novel method of simultaneously sensing hydrogen concentration and temperature with a single grating sensor.

Contributions

The specific components of contribution were in developing a more accurate algorithm for detection of what we call “the flank wavelength” and investigating improvements in sensor error using polarisation maintaining fibre.

The unique shape of the PSFBG spectrum as previously mentioned poses issues when attempting to track different features of it. The original method was to track the side of a specific peak, which in the world of simulation worked well, but did not have the same reliability in the real world. Variation in light intensity from the light source, or even moving the fibre would introduce significant error. This was eventually overcome by instead tracking peaks further away from the main peak (so-called resonance

peaks) and then averaging their wavelengths. This provided significant improvements to measurement error.

When the fibre optic cable (not part of the sensor, just leading to it) is disturbed by touching or moving it, this changes the path the light inside it takes before hitting the sensor. This change in path changes the polarisation of the light, which in fact can create error in the peak location (i.e., a slight colour shift) if the cable far down the line is disturbed. To solve this, a special type of fibre called polarisation maintaining fibre (PM fibre) can be used. This forces the orientation of the light the path takes and does not change even when the fibre is disturbed. It was found through experiment that this does indeed further improve the error and for sensitive systems and could be integral for accurate measurements using this system.

Logistical Experience

Housing

As my internship was based in Munich, this proved to be one of the most difficult aspects of this experience. As you are probably aware, Munich, like many other cities in Germany, is incredibly expensive and competitive when it comes to its housing market. Many recommended WG-Gesucht as a source of available flats, however I found this not to be the case. Despite sending upwards of 110 messages, I had no luck in receiving any reply; other housing sites provided similar results. As we are not considered “students” by Studierendenwerk, student housing was also not an option. Discussing with other RISE interns as to what they did for housing, many ended up paying upwards of 1200€ a month by using either long term Airbnb or acquiring it through expensive rental agents. As these methods were financially inaccessible to me, for my three-month stay I ended up sleeping in a large 300-person barrack-style tent hostel outside of the Nymphenburg Palace which was more affordable at only 495€/month. With earplugs and a sleeping mask, it was surprisingly tolerable.

Banking

This was initially quite challenging; however, it was greatly simplified by using Wise. It is an international banking card, which provides you with a IBAN bank account (which can be used to send/receive money) in Belgium. You can open multiple sub-accounts for each currency you need and quickly convert between them. It worked on all ATM's I used here in Germany, and all card machines (assuming they are compatible with Visa/Mastercard). Nearly all the interns had one so it was easy to send money between each other, similar to Venmo or Interac E-Transfer (for Canadians). It is fixed to your bank account at home, so it was easy to load funds directly from your chequing account. Transactions are all near-immediate and the fees are minimal and clearly stated.

Phone

Some interns had unlimited roaming plans, so some stuck with their plans from back home. As my phone plan in Canada cost CAD \$15 a day for international roaming, I decided to get a pre-paid Telekom card. It was not the cheapest I saw (7 GB for 20€/month), however compared to Canada it was reasonable and most importantly as Telekom is one of the largest carriers in Germany, I never had any issues with cellphone service wherever I went, which may not be the case with smaller carriers such as O2.

Discord

One of the absolute best sources of information came from the unofficial Discord group. With nearly 270 people available, sorted by state, city, even country of origin, you were able to meet up with others nearby, quickly ask questions and get multiple responses, and receive support in many different forms, from navigating the DAAD website for insurance documents to finding interesting spots in different cities. Without the Discord I am not sure what I would have done!

Personal Experience

The experience in the RISE program I can genuinely say has been one of the best and most unique experiences of my life. I met dozens of amazing people from all over the US, Canada, and the UK, and made a few great friends from it. My coworkers have been incredible people to work with, but especially to learn from. We often did activities from more formal events like a party in the courtyard, to less formal events like meeting after work for a beer. Our lab also did a trip to Neuschwanstein which was a really great way to bond with them further. They were happy to teach me about the German customs (Mahlzeit!), their favourite foods and local spots, and were incredibly encouraging about seeing the country while I was here. I was able to see much of Germany through the ICE trains and the Deutschland Ticket (which is an absolute necessity), and really get a better understanding of Germany's history. The museums were top-notch and gargantuan, with very good discounts for students, sometimes up to 50% off the standard ticket price. Given the extremely low cost of tuition in Germany, studying and even staying here is something I will be genuinely considering now that I have experienced the higher living standards, food quality, and relaxed work culture. I have found the German people to be direct, but incredibly kind, and have cherished the culture of work-to-live, rather than live-to-work. This is something I would at the very least, like to prioritise back in Canada!