

Jim Gatheral Travel Scholarship Report

About me

My name is Fanlin Ling, and I am a second-year PhD student at the James Watt School of Engineering, University of Glasgow. My PhD project focuses on multiphysics modeling in the field of geomechanics. I feel fortunate to have been nominated for the **Jim Gatheral Travel Scholarship (£4000)** in my second year of study. This valuable scholarship provided me with the opportunity to visit the Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences in Germany, a world-leading institution in our field. Some sights from the institution are shown below.

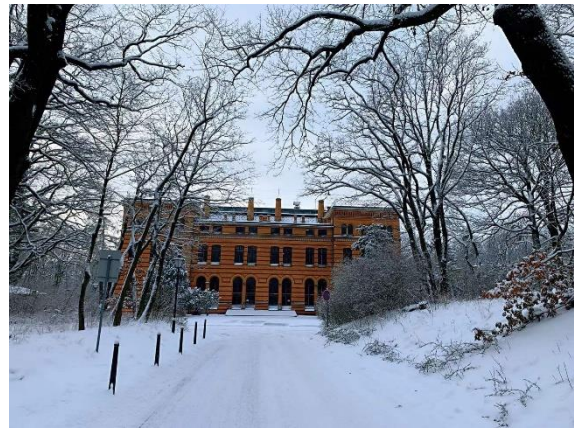


Fig. 1. Some memories in GFZ.

Why did you apply for the Travel Scholarship?

As mentioned before, my work focus on modelling, and I started writing some codes to develop a multiphysics model for fractured rock under hydro-mechanical (HM) condition, simulating fluid-solid coupling processes. Thermal effect is also one of the key points needs to be considered for geothermal energy extraction. However, the thermal effects of geothermal reservoirs (heat conduction and heat convection) are very complex. Heat conduction governs heat transport through the rock matrix and heat convection governs heat transport with fracture fluid flow through channels embedded in the rock matrix. These two processes, especially the latter one is difficult to be achieved in the current programme. A pore scale model proposed for the simulation of heat transfer from GFZ is reliable and may be associated with THM couplings in particulate systems, giving new sight to consider the thermal effects.

Furthermore, some related lab tests considering the temperature field can also be carried out to investigate the thermal-dominant process. We can get more enlightened thoughts of coupled processes from experiments directly, which will be good for validating my mathematical model under THM coupled processes, giving new insight into rock engineering in the geothermal field.

Details of your visit

During my trip, I completed the development of the mathematical model and validated it against the experimental results from GFZ. We hope that the accurate coupled THM model can be widely used for geothermal energy extraction, providing significant benefits for industrial heat and electricity production to combat climate change. The visit also enhanced our understanding of fracture initiation and propagation, offering suggestions to prevent induced seismicity during injection projects. Additionally, we held weekly group meetings to discuss our progress and questions. Here are some figures from my academic work during the visit.

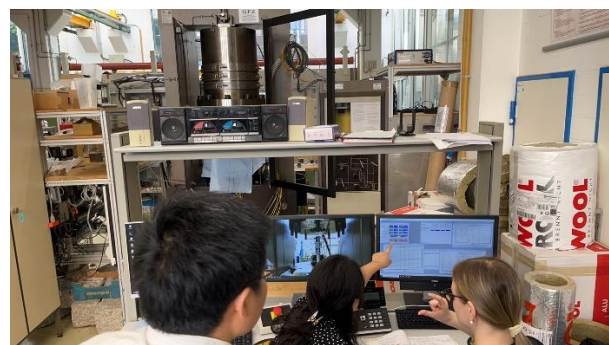


Fig. 2. Some interesting academic team work in GFZ.

During my leisure time, I was very fortunate to witness the aurora in Germany during my visit. It is rare but beautiful. Here are some pictures.

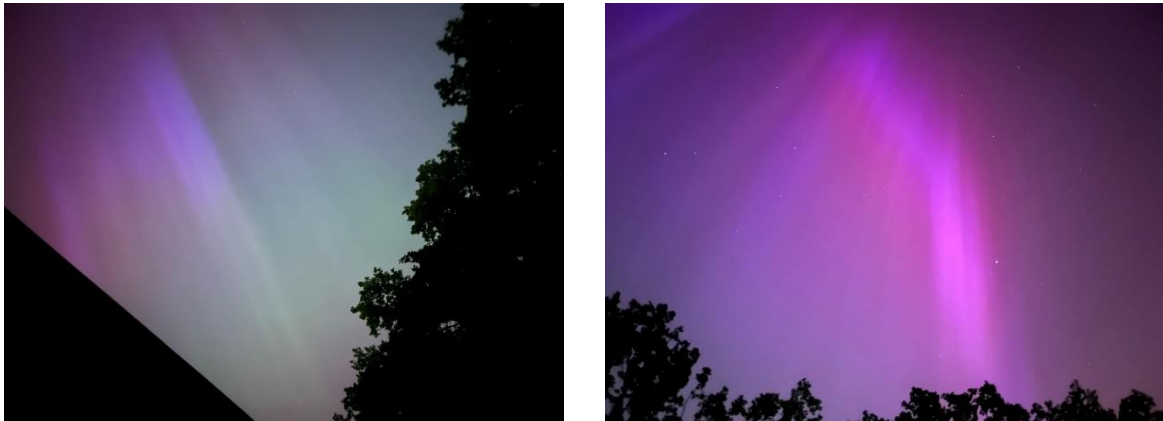


Fig. 3. Aurora in the midnight in May 2024.

Furthermore, I also visited Berlin on the weekend since it is near GFZ (Potsdam). It is a beautiful city with great sightseeing opportunities. Here are some memories from Berlin.



Fig. 4. Brandenburger Tor (left) and Berlin Cathedral (right), respectively.

Impact of the Travel Scholarship

Although this trip is not essential for the completion of the applicant's research degree, it significantly enhances the credibility of my research and facilitates its promotion and application in the field of geothermal energy. This trip is exciting and meaningful, serving as a link between the University of Glasgow and GFZ, and providing valuable insights to evaluate the geothermal potential in the UK, including projects currently being developed in Cornwall and Eden.

Furthermore, funding for PhD students greatly benefits their early research work, especially for international students, by giving them the opportunity to experience various academic styles worldwide.

Acknowledgements

I would like to express my heartfelt gratitude to the University of Glasgow and the Jim Gatheral Travel Scholarship for making this research trip possible. I also extend my thanks to Prof. Arno Zang, Prof. Hannes Hofmann, and Dr. Yinlin Ji for welcoming me to their research group and providing kind supervision during my visit. Additionally, I am grateful to my supervisor, Dr. Junlong Shang, for his support and the opportunity to collaborate with GFZ!

That was an amazing trip! I can't forget it.