

Joint application of geophysics and machine learning to mineral exploration

Supervision team

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About the project

We are experiencing the fourth industrial revolution. This revolution is different from the previous three because it is rooted in a technological phenomenon (digitalization) instead of in the emergence of a new type of energy. This transformation includes the replacement of traditional energy with renewable energy. Therefore, natural resources are needed to construct infrastructure to produce renewable energy, to increase mobility, and to develop digital life. The current rate of discovery of mineral deposits is lower than the demand of society. In part, because most mineral deposits closest to the surface have already been found and recycling techniques do not yet produce enough quantities to supply this demand. Therefore, mineral exploration has been focusing on deep subsurface regions, which requires the application of geophysical methods. Traditional 2D geophysical applications are no longer producing the desired results and this fully-funded four-year PhD project will explore 3D modeling and integration of multi-physics methods. The main objective is to construct more accurate subsurface models aiming to solve geological challenges in mineral exploration.

The project will explore the development of joint methods of inversion of geophysical data (magnetic, gravity gradient, and electromagnetic) with machine learning to advance the interpretation for defining types of rocks (not just physical properties), i.e., geology characterization. The project is flexible and can be tailored to the student's interests. Possible topics to be explored are (1) the incorporation of machine learning methods into geophysical inversion and (2) the application of machine learning to geophysical models for lithology prediction. The methods developed throughout the study will be applied to geophysical data recently (2018-2019) acquired by the Geological Survey Ireland over the Limerick Basin, which hosts large deposits of the Irish zinc field (Lisheen Mine 18.9Mt @ 15.0% Zn, Galmoy Mine 6.4Mt @ 12.4% Zn, and Pallas Green Deposit 42Mt @ 8.0% Zn). Furthermore, the advanced data science skills acquired in this project are highly valued across most industries. This project is suitable for a candidate who wishes to conduct applied research that makes an immediate impact in the real world.

Candidate profile

- Bachelor's degree in Geophysics
- MSc is desirable, but not required
- Coding knowledge (Python)
- Keen interest in geology and machine learning
- Collaborate on the open-source community
- Enthusiastic about international collaboration and overseas travel

Funding notes

A fully-funded scholarship for 4 years covers all university tuition fees, an annual tax-free stipend of €18,000, and a research grant of €4,000 per year for EU and non-EU students. The project is due to start in May 2021.

Application

Please e-mail a CV (max. 2 pages) and a cover letter (max. 1 page) outlining your experience and motivation to [Dr. Aline Melo \(aline.melo@ucd.ie\)](mailto:aline.melo@ucd.ie) by 31st of January 2021.