Scientific Area	Multiscale Systems		
Project Title	Improving the efficiency and quality of 3D seismic imaging addressing HPC aspects		
Recruiting Institution	The Cyprus Institute		
PhD awarding Institution	The Cyprus Institute	**PhD Duration**	48 Months
Supervisor/Institution	Delft University of Technology		
Co-Supervisor/Institution	The Cyprus Institute		
Secondment(s)	Analysis of seismic data - Delphi Consortium / Delft University of Technology		

Project Description

3D high-resolution seismic imaging – including the background propagation velocity model update – via the so-called Joint Migration Inversion (JMI) method is a computation- and data-intensive process. Terabytes of acoustic measurement at the Earth's surface are transformed to 3D subsurface images, making use of an optimized background speed-of-sound map. The main computational bottleneck is the iterative forward modelling of the seismic measurements, after which they are compared with the real measurements and their difference is used to update both reflection image as well as background velocity model. The gradient calculation also requires very similar processes as the forward modelling. Therefore, we seek to improve the efficiency and quality of solving this large-scale inverse problem via the following directions: i) HPC solutions of the forward modelling on both parallel CPUs and GPUs. ii) Make use of data compression and/or order reduction methods to reduce the storage, memory and calculation requirements. iii) Investigate optimum pre-conditioning of the data and/or model parameters in order to speed up the convergence of the method, optionally obtained via machine learning approaches.

Project Objectives

The basis of the method will be the currently developed JMI parallel C-code. This code will be extended and optimized according to the above described directions via (i) better HPC implementation, (ii) structurally reduce computation and memory requirements via data compression and mode-order reduction, (iii) speed up the convergence via smart pre-conditioning of data and parameters during inversion.
The final objective is to make the JMI method available at reduced computation costs and turn-around time in order to make the method available for a broader range of acoustic imaging applications, such as seismic imaging for subsurface storage (e.g. CO2 or H2) and near-surface analysis.

Required Candidate Qualifications

We are looking for candidates that meet the following requirements:

- M.Sc. in one of the following relevant fields is required: Applied mathematics, Physics, Computational Science or Engineering, Geophysics.
- Proficiency in a programming language such as C, C++, Fortran, etc.
- Experience in parallel programming and HPC technologies (e.g. OpenMP, MPI, OpenAcc, CUDA)
- Experience with HPC codes and workflows from simulation science that deal with inverse problems.
- Knowledge in HPC hard- and software and related AI methods.
- Strong academic record in the relevant fields, including presentations at international meetings and at least two peer-reviewed journal publications.
- High-level communication and writing skills
- Proficiency in oral and written English
- Excellent interpersonal skills and ability to work as part of an interdisciplinary team