Institut für Angewandte Geophysik

Themen für Abschlussarbeiten / *Topics for Theses*

Master-Arbeit / *MSc. Thesis*

Thema/*Topic*

Development of an open source framework for 1D inversion of loop source TEM data based on pyGIMLi

Beschreibung/*Description*

Loop-source Transient Electromagnetic (TEM) methods are a highly valuable tool for groundwater exploration and hydrogeophysical investigations, among others, providing depth sensitivity of up to approximately 200 m depending on subsurface conditions and acquisition parameters. In many hydrogeological and geological settings, subsurface structures can be adequately described using 1D models, allowing robust and computationally efficient interpretation of TEM data.

This MSc project aims to integrate an existing loop-source TEM forward solver into the pyGIMLi framework (e.g., based on empymod). The implementation will support flexible transmitter–receiver configurations and enable forward modeling of conventional ground-based TEM systems. Building on this forward operator, a 1D inversion framework will be developed using a Marquardt–Levenberg optimization scheme. Different regularization strategies, including first- and second-order smoothness constraints (R1 and R2), will be implemented and evaluated.

To assess model parameter uncertainty and resolution, advanced uncertainty quantification approaches will be incorporated, including hybrid Marquardt–Levenberg–Monte Carlo methods and Singular Value Decomposition (SVD) analysis. In addition, line-search strategies will be implemented to optimize regularization parameters; calibration factor correction, and data transformation approaches may be considered. The integration and influence of a priori information on inversion stability and model reliability will also be investigated.

The project will contribute to the development of robust 1D TEM inversion framework within pyGIMLi and support improved quantitative interpretation of TEM data.

Sprache/*Language*

English

Ansprechperson / *Contact person*

Dr. Pritam Yogeshwar, Prof. Dr. Thomas Günther

+45 (0) 511/643-2269

pritam.yogeshwar@liag-institut.de

Veröffentlichungsdatum / *Publication date: 20.02.2026*