

Master's Project Proposal: Geomagnetically Induced Currents

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Introduction and Goal:

Geomagnetically induced currents (GIC's) are a significant concern arising from space weather events, impacting critical infrastructure such as power grids, pipelines, and railway systems. Understanding and mitigating these impacts require comprehensive measurement and hazard assessment.

The goal of this project is to develop South Africa's first empirical model of GIC by analysing data recorded at a Magneto-Telluric (MT) station in central South Africa. Utilizing the Dual Magnetometer Method (DMM), the project aims to calculate GICs under a major ESKOM power line during geomagnetic storms.

Methodology

- **Identifying Geomagnetic Storm Occurrences:**
Identify geomagnetic storm events during the recording period at the Dealesville MT station, utilizing relevant space weather data.
- **Background Geomagnetic Field Interpolation:**
Using an adaptation of the SECS interpolation method, infer the background geomagnetic field during any data gaps at the Dealesville MT station. This interpolation can be performed using data from nearby magnetometer observatories such as Hermanus or Hartebeeshoek.
- **Determining GIC using DMM Technique:**
Employ the Dual Magnetometer Method to determine GIC under the power line. By measuring magnetic fields simultaneously under the power line and at a remote location, any difference observed can be attributed to local GIC. Ampere's Law will be applied to calculate GIC accurately.
- **Statistical Model Development:**
Develop a statistical model of equivalent GIC based on DMM measurements, utilizing an appropriate standard geomagnetic activity index (e.g., Dst or Kp, or a combination). This model will provide insights into the relationship between geomagnetic activity and GIC occurrences.
- **Optional: Estimating Local Ground Conductivity:**

Estimate the local ground conductivity at the MT station.