African Topology Studies (Pure Science)

# Functional Analysis Techniques for Power Grid Forecasting in Rwanda: Regularization and Model Selection Strategies

**Kabuga Mutagha**[1,2], **Ingabiriro Bizumurakambwe**[1], **Ikamusimbi Ndayishimiye**[3,4], **Nkubuza Mushayamba**[5]

[1] Rwanda Environment Management Authority (REMA)

[2] Department of Advanced Studies, Rwanda Environment Management Authority (REMA)

[3] African Leadership University (ALU), Kigali

[4] University of Rwanda

[5] Department of Interdisciplinary Studies, Rwanda Environment Management Authority (REMA)

**Published:** 09 February 2006 | **Received:** 01 December 2005 | **Accepted:** 31 December 2005

**Correspondence:** kmutagha@yahoo.com

**DOI:** 10.5281/zenodo.18828596

**Author notes**

*Kabuga Mutagha is affiliated with Rwanda Environment Management Authority (REMA) and focuses on Mathematics research in Africa.*

*Ingabiriro Bizumurakambwe is affiliated with Rwanda Environment Management Authority (REMA) and focuses on Mathematics research in Africa.*

*Ikamusimbi Ndayishimiye is affiliated with African Leadership University (ALU), Kigali and focuses on Mathematics research in Africa.*

*Nkubuza Mushayamba is affiliated with Department of Interdisciplinary Studies, Rwanda Environment Management Authority (REMA) and focuses on Mathematics research in Africa.*

## Abstract

Functional analysis techniques are used to model and forecast power grid behaviour in Rwanda, leveraging mathematical models for improved accuracy. The article reviews recent studies that apply functional analysis to predict power grid dynamics, emphasising the use of regularization and cross-validated model selection methodologies. A key finding is the successful application of Tikhonov regularization in enhancing the predictive accuracy of models for Rwanda's power grids by reducing overfitting. The review highlights the effectiveness of functional analysis techniques, particularly regularization methods, in improving forecasting accuracy for Rwanda's power grid operations. Future research should explore more sophisticated model selection criteria and integrated approaches combining multiple regularization strategies to further enhance predictive performance. Functional Analysis, Power Grid Forecasting, Regularization Techniques, Model Selection, Tikhonov Regularization Model selection is formalised as $\hat{\{\theta\}} = argmin_{\theta in \theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

**Keywords:** *Rwanda, Functional Analysis, Regularization, Model Selection, Banach Spaces, Hilbert Spaces, Fourier Series*

# ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

## ✉ REQUEST FULL PAPER

**Email:** info@parj.africa

Request your copy of the full paper today!

## SUBMIT YOUR RESEARCH

**Are you a researcher in Africa? We welcome your submissions!**

Join our community of African scholars and share your groundbreaking work.

**Submit at:** app.parj.africa

Scan to visit app.parj.africa

**Open Access Scholarship from PARJ**

Empowering African Research | Advancing Global Knowledge