Nonlinear Differential Equations Framework for Power-Grid Forecasting in Uganda Using Finite-Element Discretization with Error Bounds Analysis

Kizza Mukasa[1]

[1] Department of Advanced Studies, Uganda Christian University, Mukono

Author notes

Kizza Mukasa is affiliated with Department of Advanced Studies, Uganda Christian University, Mukono and focuses on Mathematics research in Africa.

Abstract

Nonlinear differential equations are essential in modelling complex systems such as power grids, which exhibit nonlinearity due to interactions between various components like generators and loads. Finite-element methods are employed to discretize the nonlinear differential equations governing the power-grid dynamics, enabling numerical simulations that account for spatial variations and discontinuities. Error analysis is conducted to assess the reliability of these forecasts under finite-element approximation. Theoretical analysis and finite-element simulation results demonstrate the feasibility of applying nonlinear differential equations for accurate power-grid forecasting in Uganda's complex grid environment. The framework provides a robust method for improving grid stability and reliability predictions. Recommend further empirical validation through real-world data integration, alongside exploring potential improvements to the error bounds analysis technique. The analytical core is $\hat{y}_t = \mathcal{F}(x_t; \theta)$ with $\hat{\theta} = argmin_\theta L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: *Uganda, Nonlinear Systems, Differential Equations, Finite Element Method, Error Analysis, Grid Modelling, Dynamical Systems*

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