



Finite-Element Discretization and Error Bounds for Nonlinear Differential Equations in Power-Grid Forecasting in Ethiopia: A Mathematical Approach

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Abstract

The accurate forecasting of power-grid operations in Ethiopia is crucial for ensuring stable electricity supply to meet growing demand and minimise disruptions. The methodology employs finite-element methods to discretize nonlinear differential equations governing power-grid dynamics. A key assumption is the applicability of linear elasticity theory under certain conditions within this context. The method's effectiveness is ensured by leveraging established properties of finite-element solutions, such as approximation and stability. A specific error bound for a particular class of nonlinear differential equations has been derived using finite-element discretization techniques, offering insights into the model's predictive accuracy in Ethiopian power-grid scenarios. This study provides a robust mathematical foundation for improving the reliability of power-grid forecasting models by integrating advanced numerical methods and theoretical analyses. Future research should explore broader applications of these finite-element techniques across different regions to validate their generalizability and effectiveness in real-world settings. Power-Grid Forecasting, Nonlinear Differential Equations, Finite-Element Methods, Error Bounds, Ethiopia The analytical core is $\hat{y} t = \mathcal{F}(xt; \theta)$ with $\hat{\theta} = \operatorname{argmin}_{\theta} L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: Ethiopia, Nonlinear Equations, Finite-Element Method, Grid Stability, Error Analysis, Differential Equations, Numerical Approximation

ABSTRACT-ONLY PUBLICATION

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