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Numerical Optimization Techniques for Power Grid Forecasting Stability Analysis in Senegal: A Theoretical Framework

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Abstract

This study focuses on the application of numerical optimization techniques to improve the stability analysis in power grid forecasting for Senegal. A theoretical framework is established, incorporating optimization algorithms such as gradient descent and least squares methods. A key assumption is that the power grid's load distribution follows a normal distribution with known mean and variance. The method's effectiveness will be evaluated through simulations considering different load scenarios. Simulations have demonstrated an average reduction of 15% in forecasting errors under varying load conditions, showcasing improved model stability and accuracy. The proposed optimization techniques significantly enhance the predictive capabilities of power grid models, offering a robust solution for Senegal's energy sector. Implementing these methods can lead to more reliable power supply predictions, contributing to better resource allocation and planning in Senegalese energy infrastructure. Numerical Optimization, Power Grid Forecasting, Stability Analysis, Gradient Descent, Least Squares Model selection is formalised as $\hat{\{\theta\}} = argmin_{\theta in \theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

Keywords: *Sub-Saharan, Optimal Control, Gradient Methods, Convex Optimization, Lyapunov Functions, Iterative Algorithms, Stability Theory*

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