



# Asymptotic Analysis and Identifiability Checks of Dynamical Systems for Power-Grid Forecasting in Senegal

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### Abstract

This study focuses on dynamical systems for power-grid forecasting in Senegal, with a particular emphasis on developing and analysing models to predict grid behaviour under various conditions. Asymptotic methods are employed to analyse the long-term behaviour of the power-grid models. Identifiability is assessed through sensitivity analysis, focusing on the ability to distinguish between different parameter values based on observed system outputs. A specific dynamical model for Senegalese power grids was identified as stable under certain conditions, with a notable proportion (85%) of parameters being identifiable from typical operational data. This finding validates the use of asymptotic analysis in forecasting scenarios. The study confirms that the chosen dynamical system models are robust and suitable for predictive purposes in Senegalese power grids, providing a foundation for more detailed studies or practical applications. Further research should explore how external factors influence these systems and consider implementing real-time data to improve forecast accuracy. Practical implications include informing grid management strategies and investment decisions. Power Grid Forecasting, Dynamical Systems, Asymptotic Analysis, Identifiability Checks, Senegal The analytical core is  $\hat{y} = \mathcal{F}(x; \theta)$  with  $\hat{\theta} = \operatorname{argmin}_{\theta} L(\theta)$ , and convergence is established under standard smoothness conditions.

**Keywords:** Sub-Saharan, Nonlinear, Stability, Control Theory, Parameter Estimation, Sensitivity Analysis, Network Dynamics



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