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Finite-Element Discretization and Error Bounds for Traffic Flow Optimization in Ethiopia Using Partial Differential Equations

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Abstract

This study examines the application of partial differential equations (PDEs) for optimising traffic flow in Ethiopia, focusing on finite-element discretization techniques. A partial differential equation model was formulated to represent traffic flow dynamics in Ethiopia. Finite-element discretization was employed to convert the continuous problem into discrete elements, enabling computational analysis. Error bounds were derived based on known stability properties and convergence criteria. Error bounds for the finite-element solutions have been rigorously established, ensuring that numerical approximations closely match the true solution within a specified proportion (e.g., less than 5%). The study successfully demonstrates the feasibility of using PDEs and finite-element methods to optimise traffic flow in Ethiopia with quantifiable error control. Further research should explore scalability and real-world applicability, while validation studies are recommended for empirical testing. Under standard regularity and boundary assumptions, the forecast state is modelled by $partialt\, u(t,x) = \kappa ¿ \partial\{xx\} u(t,x) + f(t,x)$, and stability follows from bounded perturbations.

Keywords: *Ethiopia, Partial Differential Equations, Finite-Element Method, Discretization, Error Analysis, Optimization Techniques, Computational Fluid Dynamics*

ABSTRACT-ONLY PUBLICATION

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

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