

Research on interpolation algorithm using RBF neural network in fuzzy reasoning method based on hedge algebra and application in control

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Abstract: This study proposes a novel interpolation algorithm utilizing Radial Basis Function (RBF) neural networks within the framework of hedge-algebra-based fuzzy reasoning. Traditional fuzzy interpolation methods often struggle with sparse rule bases and the semantic integrity of linguistic terms. By integrating RBF networks, which excel at function approximation and local generalization, with the algebraic structure of hedge algebras, the proposed method ensures both numerical accuracy and the preservation of inherent linguistic meaning. The algorithm learns the mapping between input-output data points and the underlying hedge algebra structure, enabling effective reasoning even when the rule base is incomplete. The performance of the approach is validated through its application to a nonlinear control problem. Simulation results demonstrate that the proposed method achieves superior control precision and smoother response compared to conventional fuzzy interpolation techniques. This work provides a robust framework for intelligent control systems requiring both interpretability and high performance under sparse data conditions.

Keywords: RBF neural network, hedge algebra, fuzzy reasoning, interpolation algorithm