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A Deep Learning-Based Tool For Dipole Antenna Current Prediction And Visualization

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Introduction

Antenna design is crucial for telecommunications and electromagnetic engineering, where predicting current distribution within an antenna is vital for optimization. Traditional prediction methods are manual, time-consuming, and require domain expertise [1]. This paper presents a deep learning-based tool for dipole antenna current prediction, combining real-time dataset generation and visualization. The tool automates predictions and simplifies the process, making it accessible to non-specialists.

Main Section

The Dipole Antenna Current Prediction Tool integrates deep learning models and dataset generation to predict the real and imaginary components of antenna currents based on parameters like radius, length, and segment count.

1. Dataset Generation

Synthetic datasets are generated using classical electromagnetic theory [2] to simulate the current distribution along an antenna. The tool calculates the impedance matrix and voltage distribution, which are used for model training.

2. Data Preprocessing and Scaling

Input parameters (radius, length) and output values (current) are scaled using the Standard Scaler from sklearn, ensuring consistent data distribution for better model accuracy [3].

3. Model Architecture

The deep learning model consists of an input layer, hidden layers with ReLU activation and dropout regularization, and an output layer predicting both real and imaginary current components.

4. Training and Prediction Process

The model is trained using Mean Squared Error (MSE) and Adam optimizer. After training, it predicts current values for new inputs, evaluated using Root Mean Square Error (RMSE) and Mean Absolute Error (MAE).

5. Work Flow and File Management

The tool organizes datasets, models, actual values, predictions, and plots into directories for efficient file management during prediction tasks.

Conclusion

The Dipole Antenna Current Prediction Tool simplifies antenna current prediction through deep learning, providing real-time predictions with a user-friendly interface. It allows non-specialists to input antenna parameters and receive instant predictions, democratizing access to advanced antenna analysis technologies. Future improvements include scalability enhancements, parallel processing for large datasets, and further model tuning.

References

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