Metallic Pattern Prediction for Surface Wave Antennas Using Bidirectional Gated Recurrent Unit Neural Network

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In our recent FMCW vertical-looking radar system design [1], an antenna with cosecant-squared far-field radiation pattern is necessary for radar data processing. Conventional techniques that forms cosecant-squared pattern are incompatible with the compact radar system. Therefore, a low profile and compatible surface wave antenna, is a feasible way to achieve such radiation pattern. Curve fitting method has been performed to predict the near-zone electric field ($E$-field) of the antenna and the predicted near-field has been utilized in the far-field transformation [2].

We recently proposed a novel method to predict the metallic pattern on surface wave antennas; the desired far-field radiation pattern of the antenna is served as the input to a neural network prediction model. The method is mainly divided into two parts: i) the far-field radiation pattern to near-zone $E$-Field, and ii) from near-zone $E$-field to metallic pattern on the surface. This paper focuses on demonstrating how the metallic pattern of the antenna can be predicted by using the near-zone $E$-Field data. The near-zone $E$-field data extracted from CST simulation software is utilized as the training data for the bidirectional gated recurrent unit (Bi-GRU) neural network model. The metallic pattern attached above the substrate is converted to binary numbers as the study label of the Bi-GRU. The Bi-GRU can then be applied to predict the metallic pattern of the antenna.

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The metallic pattern prediction accuracy is 100% in this case.