Fast and Accurate Radiation Pattern Evaluation Using Generative Adversarial Network

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The antenna radiation pattern plays the most important role for deployment and configuration of antennas and their arrays. In general, measuring an antenna's radiation pattern and gain is very time-consuming and is limited to specific planes or angles. Hence, it is an urgent task to develop new measurement and characterization techniques that enable fast and accurate evaluation of radiation patterns of antennas placed in realistic environments, especially for the future 5G network with massive base stations in noisy environments. In this work, we demonstrate for the first time that a new class of neural network architecture, generative adversarial network (GAN), that can rapidly and accurately evaluate the radiation pattern of antennas and their arrays. Different from traditional machine learning methods, GAN can learn how to generate new data with the same statistics as the training set and can be particularly useful for generating images that look authentic to human observers. In the same vein, GAN may allow one to exploit the limited measurement data to evaluate the detailed radiation pattern with sidelobes and nulls. In GAN, generator is first fed with different antenna geometries and fragments of radiation pattern. Then, the GAN generator attempts to create (recover) the entire radiation pattern in angular space, while the discriminator will compare the similarity between the real plot and the one produced by the generator. Finally, the generator is expected to complete the entire radiation pattern of the antenna, even though a few data points are known. As a result, the proposed GAN model can measure the 3-D radiation pattern of an antenna without tediously measuring the radiated power at all angles, resulting in a significant reduction in the measurement time.