Helical Antenna Optimization Using Genetic Algorithms

by

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(ABSTRACT)

The genetic algorithm (GA) is used to design helical antennas that provide a significantly larger bandwidth than conventional helices with the same size. Over the bandwidth of operation, the GA-optimized helix offers considerably smaller axial-ratio and slightly higher gain than the conventional helix. Also, the input resistance remains relatively constant over the bandwidth. On the other hand, for nearly the same bandwidth and gain, the GA-optimized helix offers a size reduction of 2:1 relative to the conventional helix. The optimization is achieved by allowing the genetic algorithm to control a polynomial that defines the envelope around which the helix is wrapped. The fitness level is defined as a combination of gain, bandwidth and axial ratio as determined by an analysis of the helix using NEC2.

To experimentally verify the optimization results, a prototype 12-turn, two-wavelength high, GA-helix is built and tested on the Virginia Tech outdoor antenna range. Far-field radiation patterns are measured over a wide frequency range. The axial-ratio information is extracted from the measured pattern data. Comparison of measured and NEC-2 computed radiation patterns shows excellent agreement. The agreement between the measured and calculated axial-ratios is reasonable. The prototype GA-helix provides a peak gain of more than 13 dB and an upper-to-lower frequency ratio of 1.89. The 3-dB bandwidth of the antenna is 1.27 GHz (1.435 GHz – 2.705 GHz). Over this bandwidth the computed gain varies less than 3 dB and the axial-ratio remains below 3 dB.

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