Imbedded Microstrip and Helical Antennas as Sensors and Communicators: Sane Application of Genetic Algorithms

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Many of today's biological sensors, medical implants, and emerging artificial vision, hearing, and muscle control electronics are sufficiently small that they can be imbedded in the human body. These imbedded sensors require communication systems to retrieve the data or control the device. Other applications for imbedded sensors include remote moisture, composition, and weather monitoring for precision agriculture, food processing, manufacturing, etc. This paper describes a set of sensors that have been developed for either remove sensing or communication or the combination of the two.

The genetic algorithm approach has been applied to optimize the designs of these antennas, resulting in improvements to existing designs and new designs as well. While the application of genetic algorithms has been shown in some cases to provide improved antenna designs, it remains a "scientists' tool" rather than a mainstream antenna design method. This is because the methods of applying the GA to a realistic problem, which has multiple facets of the antenna to be simultaneously optimized, requires significant expertise to adequately design the cost function and parameter space for convergence and effective GA design. In addition, the amount of computer time required becomes extremely large as the parameter space is increased in any meaningful way. The practical aspects of applying the GA to these problems is addressed, with the intention of providing a nearly "knowledge-free" application design program that allows a user who knows little or nothing about a GA to apply the method with reasonable success to an imbedded antenna design problem.

This method is demonstrated in the design of a wireless soil moisture sensor with both underground sensing antennas and above ground communication antennas in a complex environment.