Commission B

MULTI-BAND HANDSET ANTENNA DESIGN USING A GENETIC ALGORITHM

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Abstract:

The wireless revolution has created a flood of new devices that has dramatically increased the availability and quality of voice and data almost worldwide. The devices are small with improved functionality and are largely design driven by ergonomic and aesthetic criteria. This places further limits and performance demands on the bandwidth and efficiency of the antenna. Recently, triple-band (GSM, DCS and PCS) handsets have been readily available in the market. The succeeding products will require accommodation for complementary services such as Bluetooth™ and UMTS. This creates the need for enhanced bandwidth on the antenna.

To achieve this multi-band operation, a Genetic Algorithm (GA) has been used to design a patch antenna operating at dual-band GSM-900 MHz and DCS-1800 MHz as a first step to lead to a multi-band handset antenna design. Genetic algorithms are search algorithms based on the mechanics of natural selection and natural genetics. They combine survival of the fittest among string structures with a structured yet randomized information exchange to form a search algorithm with some of the innovative flair of human research [1]. In every generation, new set of artificial creatures (chromosomes) are created using random features of the preceding best fit of the old generations. They efficiently exploit historical information to speculate on new search points with expected improved performance. The GA uses an evaluation function to optimise the return loss S_{11} of the produced generations to maximize antenna bandwidth at the required frequency bands by changing the antenna geometry.

The implemented GA was used to design an electrically small antenna that fits in the restricted volume of a mobile handset. The objective of using the GA is to shorten the design cycle that would otherwise be carried out by an engineer iterating manually. The most important factors that limit the time that the GA requires to optimise the design is the number of generations produced in each cycle and number of geometry parameters varied, not withstanding the individual simulation run times.

The obtained design of this dual-band antenna using the GA consists of a rectangular patch of 6mm height above the ground plane, a shorting wall close to one of the patch corners and a coaxial cable that feeds the antenna on the upper edge of the patch. The return loss and the radiation performance of the produced antenna were investigated using a commercial electromagnetic simulation package: CST Microwave Studio™. The antenna is a small size, simple geometry, low cost and suitable for dual-band GSM900/DCS1800 handsets. In the future the presented antenna can be modified and its shape repeated on the same patch to feed it again to the GA in order to produce a multi-band handset antenna.

[1] David E. Goldberg "Genetic Algorithm in Search, Optimisation, and Machine Learning" 1998 by Addison-Wesley