Non-ionizing radiation mapping based on Geographical Information Systems

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ABSTRACT

Due to the increment in infrastructures built by telecommunication companies in El Salvador, the Superintendency of Electricity and Telecommunications (SIGET) decided to perform measurements for the electrical field values produced by these equipment throughout the country to determine whether or not they represent a risk for the population.

To help with this problem, the Electronics and Informatics Department at the Universidad Centroamericana "José Simeón Cañas" worked in the development of computational tools able to present digital mappings using two different methods for the prediction of the non-ionizing radiations.

A first implementation makes use of Triangular Irregular Networks (TINs) to take advantage of its modelling properties to create more precision for the ground irregularities in the areas of interest; and utilizes regular matrices to ease the analysis process. These data structures were applied over electrical field values already obtained by the authorities to create digital terrain models, which in turn were taken as input for an implementation of the Simplified Two-Ray algorithm as a problem type for the pre- and post-processor GiD to allow the evaluation and visual representation of the electrical field values by means of a simulation.

A second implementation using the Ray-Tracing method [1] was chosen as the next step due the characteristics of the problem: VHF and UHF operation frequencies, indoor and outdoor propagation types, and the need for reflection, diffraction and refraction simulations. This method allows for a direct prediction of the electrical field value at any point of interest, and also a very precise modelling of the propagation environment; the method also performs simplifications over the Maxwell equations to obtain approximated versions that can be applied to discretized domains [2]. Further simplifications for the problem, based on the tropospheric nature of the propagation environment for the local frequency values, are [3]: unity, constant and homogeneous permeability, constant and homogeneous refraction index, and lineal and lossless propagation medium.

For the implementation, a half-wave dipole antenna was used, and a 3-D model was created, representing the geographical surface of the area of interest and using the digital terrain models previously generated. This surface model is defined as a triangular mesh, and the variable values inside the triangular elements are calculated taking advantage of their barycentric coordinates.

After comparing the results for this second simulation against available general purpose software tools and previously manual-measured values, it was concluded that the implementation is precise enough to be considered successful and ready for future improvements and development phases.

REFERENCES

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