Analysis of the influence of forestry environments on the accuracy of GPS measurements by means of recurrent neural networks

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Abstract

The present paper analyzes the influence of the forest canopy on the accuracy of the measurements performed by a global positioning system (GPS) receiver located under forested environments. A large set of observations were taken with a GPS receiver in intervals of 1 second during a total time of an hour in twelve different points placed in forest areas. Each of these areas was characterized by a set of forests canopy variables (tree density, volume of wood, Hart-Becking index, etc.) The influence on the accuracy of the measurements of other variables related to the GPS signal, such as the Position Dilution of Precision (PDOP), the signal-to-noise ratio and the number of satellites, was also studied.

Recurrent neural networks (RNN) were applied to build a mathematical model that associates observations errors and GPS signal and forest canopy variables. A recurrent neural network (RNN) is a class of neural network where connections between units form a directed cycle. This topology allows them to exhibit dynamic temporal behavior. This property and their ability to discover patterns in nonlinear and chaotic systems made of the RNN a suitable tool for the study of our problem.

The results obtained are in line with those achieved by the authors in previuos research using different techniques and showed that the variables that have the highest influence on the accuracy of the GPS measurements are those related with the forest canopy, that is, the forest variables. The influence of these variables is almost equally important without significant statistical differences. As was expected, those observations recorded in areas covered by an important forest canopy have larger errors than those obtained in areas with less canopy cover.

Keywords: GPS accuracy, forest canopy, recurrent neural network, regression model