Theme: GNSS positioning

Multipath Detection using Machine Learning Techniques

For many applications, varying from autonomous vehicles to mobile mapping, accurate positioning is essential. Global navigation satellite systems (GNSS) are known to be a major source of absolute positioning information. There are many factors that may negatively influence the positioning quality. While under ideal conditions extremely high accuracies are possible, in the daily life this is not always achievable. In urban areas, one of the factors having a large negative impact on the positioning quality is multipath. This refers to signals from GNSS satellites reaching the antenna of the mobile receiver via multiple paths. Often a receiver can collect a combination of direct and indirect signals or sometimes just the reflected signals. In all these cases, the GNSS receiver will collect incorrect measurements and, when these observations pass undetected, the receiver calculates incorrect positions.

Due to the complex nature of reflections, it is difficult to detect this situation. The most common way is to verify that there is consistency between the received signals from different satellites. This requires solving an overdetermined system of equations in which signals from more than 4 satellites are required to calculate a position. Although it is likely to receive signals from more than 4 satellites in the presence of multi-GNSS, in urban areas, it is highly probable to collect data from many satellites that are not directly visible. It is therefore important to classify the line-of-sight (LOS) and non-line-of-sight (NLOS) signals to obtain reliable positioning results.

The goal for this research is to investigate whether artificial intelligence (AI) technology (neural networks and deep learning) can be used to detect GNSS observations that are influenced by such reflections. There are currently different methods attempting to detect erroneous observations or to correct for the multipath effect. AI is among the possible methods that can detect unreliable GNSS data. A few features will be calculated from the raw and processed GNSS measurements to classify the GNSS observations as clean, multipath, and non-line-of-sight (NLOS). The raw data comprises the pseudo-range, signal to noise ratio, Doppler shift frequency and carrier phase measurements which can directly be obtained from the GNSS receiver. The elevation of the satellite could be another feature for this purpose. The least squares residuals of the pseudorange measurements can be considered as a feature extracted from the processed data. The extracted features will then be fed into a machine learning algorithm to train a network. The performance of the trained network will be investigated on the test (unseen) data.

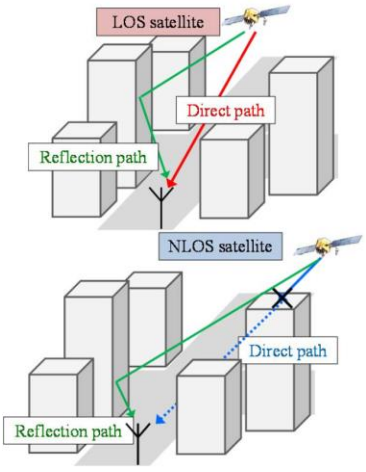

Image: L.-T.Hsu, "GNSS multipath detection using a machine learning approach," *2017 IEEE 20th International Conference on Intelligent Transportation Systems (ITSC)*, 2017, pp. 1-6

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