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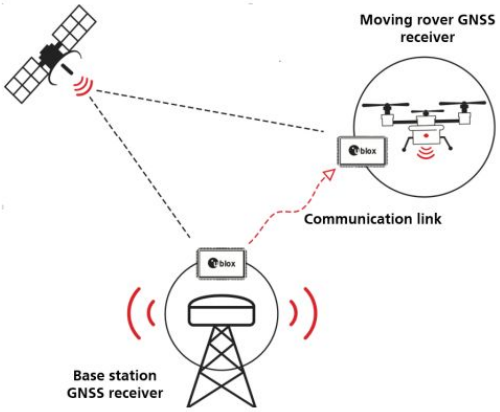
Onboard positioning for UAVs



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Abstract

Global Navigation Satellite Systems (GNSS) is the developing trend for positioning especially for the purpose of surveying a land or tracking a receiver's position. With our UAVs which were connected to our GNSS boards we were able to track and save continuously the position of a receiver from start to finish with a centimeter-based accuracy. To achieve this level of precision we spend a lot of time studying the existing GNSS modules. We will discuss the entire process from the study we made to choose our module to the configuration and program we wrote to pilot our base and receiver.

Introduction

As far as positioning chips are concerned it is well known that the main focus is and has always been accuracy. Usually used in surveying the issue has been how much more accurate can those chips become. GPS is the american positioning system and because of that the satellites that are used to convey the location of a particular point are few and give a merely accurate location. The common being of about one meter or more, several companies started to reconsider the process in order to minimize the chips size while reducing the precision to centimeters. In recent years, U-blox, a swiss company, has been dropping a series of high precision GNSS modules with a centimeter-based accuracy such as the NEO-M8P and the recent ZED-F9P.

Methods, Materials and Experimental Procedures

RTK for Real Time Kinematics and PPK for Post-Processed Kinematics are basically the two main technologies used to convey GPS data to receivers. After reviewing the good and the bad of each of them we choose RTK because of the quickness with what it gives the current position by correcting the data in real-time. Thus, we studied all the available modules in order to find the most suitable one based on certain criterias which we had established beforehand. The purpose was to find a GPS module which we will plug onto our two drones. Therefore we will use one of them as a base station which will convey the correction data to our receiver surveying an area closeby.

Results

Our results showed that two major technologies were used for positioning : RTK and PPK. And after a minituous comparison we choose to continue with RTK because of the real-time correction of data which ensures that at any given time, tha position we are getting is the most accurate and we are getting it the fastest. So we choose the C099-F9P board which contains a ZED-F9P module which is a RTK module developed by U-blox.

After the choice was made we started to configure and program our board. To do so we had to install ucenter which is a configuration platform and after setting one of our boards as a base station and the other as a rover(receiver), we had to program their behaviour using Arduino and his GNSS library. In the end the accuracy was about 2.5 centimeters.

Then the last part consisted in testing our boards by placing them on one of the drones and making it survey a little area behind the school. We were able to go beyond 300 meters of distance from the base with the rover drone (receiver).

Discussion

At this point we can conclude that RTK can provide a centimeter based accuracy and real-time correction data. When it comes to recording the position, the situation is more complicated. Relatively the PPK is more durable because it can still record the position even if the connection is running out. Besides that with a 2.5 centimeter precision, we can surely use the positions recorded in the field tests to compare to Nathan Itare's algorithm calculations with his microphones based positioning system.

References

[1] U-blox's F9 Multi-band Gnss Module With Rtk Delivers Centimeter-level Accuracy In Seconds

[2] The Taming of the u-blox ZED-F9P, Roby, Deep South Robotics

Tables and data