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IMPLEMENTATION OF A LOW-COST GPS-RECEIVER FOR A STUDENT ROCKET

Abstract

Student rockets are used as a part of space technology courses at several Norwegian universities. The rockets are equipped with basic sensors such as temperature and pressure sensors. In order to get a better track of the flight path, a GPS-receiver is useful. The transmitted GPS coordinates can also be used in order to more easily retrieve the rocket payload after landing, if desired. A test version of the GPS-payload will be launched on a rocket provided by The national center for space related education (NAROM) in collaboration with Andøya Space Centre at the end of March this year.

Low-cost GPS receivers are not made to withstand high acceleration. There are also restrictions regarding velocity and altitude. These, however, are statutory constraints which only apply if both velocity and altitude exceed their respective limits. The student rocket will reach an altitude of approximately 9000 m with a spin of 20 Hz. The maximum acceleration and velocity will be approximately 20g and 1000 m/s respectively. The purpose of this project is to investigate how these factors will affect the receiver, how these challenges can be resolved, and build the receiver accordingly.

The receiver consists of an active GPS antenna connected to a GPS module and a microcontroller. The main task is to receive signal from the GPS satellites through the antenna, and then parse, process and pack the data. An important part of this process is to reduce the Time To First Fix (TTFF) by avoiding cold starts, as this is decisive when dealing with high velocities. In the end, the signal will be transmitted to the ground station via the transmitter card in the rocket, and the received telemetry must be parsed to retrieve readable coordinates.

The acceleration of the rocket exceeds the manufacturers operating limits of the chosen GPS module. This means that the receiver only receives the signal after the acceleration phase of the flight has ended. Because the expected altitude is well within its bound, the exceedingly high velocity should not be an issue. However, as it is not given any explicit constraints by the manufacturer regarding spin, another challenge was then to investigate whether or not our receiver could handle the spin of the rocket. This paper will present our findings, prototype implementation and results.