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ANALYSIS OF RECEIVED AIS DATA FROM AN LEO CUBESAT

Abstract

The AAUSAT3 satellite is a 1U cubesat, which has been developed by students at Aalborg University, Denmark in collaboration with the Danish Maritime Authority. The satellite was launched into a polar DD-SSO orbit of 800 km altitude on February 25th 2013 on a mission to monitor ships from space using their AIS broadcast signals as an indication of position by means of a simple dipole antenna.

The SDR based receiver used on board the satellite is using a single chip front-end solution, which downconverts the AIS signal located around 162 MHz to an intermediate frequency at 200 kHz. This I/Q signal is sampled with a 750 kSPS A/D converter and further processed by an Analog Devices DSP. The algorithm first analyses the stream to identify possible AIS transmissions on the two different AIS channels. If likely transmissions are identified, the center frequency of the transmission is estimated in order to compensate for the Doppler shift due to the large speed difference between the satellite and the ships. After this a noncoherent demodulation takes place using the estimated center frequency.

The initial SW in the SDR was implemented as a sample and process algorithm, since the primary mission of the satellite was to perform a feasibility study about the possibility of detecting AIS signals from a 1U cubesat in LEO. However, soon after launch it was found, that the AIS receiver performed very well and an improved algorithm which samples and decodes real-time was developed and uploaded to the satellite. This improved algorithm gave a more than 10 fold improvement in detection rate and more than 10k AIS packets/hour are now being detected on average (only counting position reports).

It has been found, that it is possible to detect AIS signals from ships around the world using a 1U cubesat in LEO. Improvements to the SDR algorithms have been identified after the launch of the satellite, and these improved algorithms have been uploaded to the satellite. Although able to detect more than 10k packets/hour it is also found that the large field of view and high number of ships in heavily congested areas yields many colliding packets, impacting receiver performance. As a result, only few AIS messages have been decoded from areas such as the Mediterranean area and near the English Channel.