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SDR-BASED SYNTHETIC APERTURE RADAR FOR EO MISSIONS

Abstract

GAMALINK is a versatile Software-Defined Radio (SDR) based platform designed and produced by TEKEVER, targeted at supporting ad-hoc networks of communicating satellites and ground stations. Further to its SDR characteristics, this compact platform also includes processing capacity, including a FPGA and a Cortex M4 DSP. Further to its communications and networking capacity, GAMALINK also supports link monitoring, precision ranging and time synchronization and GPS reception. It has recently been upgraded to support Synthetic Aperture Radar (SAR).

The SAR waveform is a 1 to 2 microsecond pulse consisting of a Kaiser windowed chirp of 80 MHz bandwidth, leading to a range resolution of less than 2 meters. Flexibility in waveform generation and carrier frequency fast tuning allows for combination of multiple pulses to obtain configurable larger bandwidths and corresponding better range resolutions. Although flexible in frequency, it is being used in both L and S bands.

SAR range compression is directly performed in the FPGA immediately following the RF chain and ADC. Since transmission and reception share the same low PPM clock source, phase shift between transmission and reception is kept stable. The same applies for the sampling delay between transmission and reception, providing accurate data for azimuth compression. Range compression is performed in real time, allowing for a pulse repetition rate (PPR) of any value respecting the maximum target range (adjustable) and the maximum data rate between the FPGA and the image generation processor. GAMALINK can operate with PPR of up to 10 kbps.

The range-compressed echoes are transmitted to a compact high performance GPU based image processor. This processor also receives navigation data, which is used in the process of image generation. Pulses are compensated for navigation error relative to the desired path prior azimuth compression. The process of azimuth compression also includes a range migration algorithm to compensate for geometry distortions. This task is also performed in real time, providing a new image strip as the antenna travels along the flight path.

The current version of GAMALINK SAR has been tailored for short-range applications (targets situated up to few tens of kilometers away), both for airborne and for orbital non-cooperative object analysis applications. However, a new version is under development for Earth Observation applications. This paper will focus on both versions and provide an overview of the system design and capabilities.