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Author: Prof. Alfredo Renga
University of Naples "Federico II", Italy, alfredo.renga@unina.it

Mr. Antonio Gigantino
University of Naples "Federico II", Italy, ant.gigantino@studenti.unina.it
Dr. Maria Daniela Graziano
University of Naples "Federico II", Italy, mariadaniela.graziano@unina.it
Prof. Antonio Moccia
University of Naples "Federico II", Italy, antonio.moccia@unina.it
Dr. Alberto Fedele
ASI - Italian Space Agency, Italy, alberto.fedele@asi.it
Dr. Silvia Natalucci
ASI - Italian Space Agency, Italy, silvia.natalucci@asi.it

BEAMFORMING AND MULTI-PLATFORM IMAGE SYNTHESIS FOR RODIO DISTRIBUTED SAR MISSION

Abstract

RODiO (Radar for Earth Observation by synthetic aperture DIstributed on a cluster of cubesats equipped with high-technology micro-propellers for new Operative services) is an innovative mission concept selected in the framework of the Italian Space Agency (ASI) Call for future missions based on Cubesats. RODiO Phase A study is scheduled to start by mid-2022. The mission relies on a cluster of 4 CubeSats flying in formation with ASI PLATiNO-1 (PLT-1) Synthetic Aperture Radar (SAR) mission. Each CubeSat embarks a receiving-only X-band SAR instrument able to collect bistatic echoes exploiting PLT-1 as an opportunity illuminator. The CubeSat cluster flies at a safe distance of tens of km from PLT-1, and formation-flying techniques are used to keep all the CubeSats in the cluster within an overall envelope of a few hundred meters. The passive radar, including a very compact receiving unit and the proper deployment mechanisms for the antenna, is conceived to comply with a 12 U CubeSat. It is thus a multi-platform Distributed SAR (DSAR) working in passive mode, and its mission is aimed at both the in-orbit technological demonstration of DSAR concept (multi-platform image synthesis) and the delivery of SAR images for downstream. The paper focuses on the multi-platform image synthesis, i.e. the capability to synthesize an image of improved performance combining, both in amplitude and in phase, the stack of low performance bistatic images collected by each RODiO receiver, independently. The proposed solution implements a time domain multi-static beamforming algorithm which is able to both improve the Signal-to-Noise Ratio (SNR) and the level of ambiguities in the generated images, making the relevant values compliant with high-quality SAR imaging standards. The developed method also supports a timing strategy based on the tuning of the pulse repetition frequency (PRF) to avoid the values that are unsuitable for beamforming.