SAR Interferometry Capabilities of Canada's planned SAR Satellite Constellation

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Abstract

The Canadian Space Agency (CSA) has initiated the development of a low–cost small–satellite C–band SAR constellation as a follow–on project to the RADARSAT–2 program. The low–cost concept requires that the SAR system design is in terms of mass, power consumption, volume, and antenna size, in compliance with the constrains set by using a low–cost launch vehicle and a small satellite bus.

The presentation will provide an overview of the overall mission concept with a special focus on the SAR interferometry (InSAR) capabilities of the planned SAR constellation.

The current concept for the SAR constellation involves three satellites with an option of flying up to six satellites. This is to meet specific revisit and coverage requirements for ship detection and maritime surveillance such as oil spill monitoring. Other key applications envisaged for the constellation will focus on sea ice monitoring, flood mapping, and InSAR coherent change detection (CCD) of land surfaces for geohazards and environmental monitoring.

The SAR satellites will operate in two principle modes: a wide–area ScanSAR and a high–resolution strip–map mode. The wide–area ScanSAR mode with a swath width of 350 km and a 4–look medium resolution of 50 m will be used specifically for maritime surveillance and sea ice monitoring. The high–resolution mode with a 1–look spatial resolution of 5 m is intended for specific on–demand imagery acquisitions.

The configuration of the constellation is such that the satellites fly at an altitude of 600 km in the same orbital plane, following each other with a time separation of about 30 min and 15 min, respectively, depending on the number of satellites in the constellation (i.e., three or six satellites). Thereby, the ground track of each satellite is slightly shifted due to the Earth rotation, providing combined ground coverage of up to 1000 km using the wide–area ScanSAR mode.

The preliminary configuration concept envisages a 12–day repeat orbit cycle for each satellite with the goal to maintain its orbit within an orbital tube of 100 m with respect to other satellites in the constellation. This is especially interesting for InSAR applications, because for a three–satellite constellation it means that after 4 days, one of the satellites will be nearly at the same orbital position as the previous one, covering the same area on the ground. Provided that the same SAR beam mode is selected, it will enable the formation of repeat–pass interferometric data pairs with a 4–day interval. To enable long–term InSAR measurements, it will be necessary that the constellation as a whole will maintain its orbit with respect to a reference orbit within a tight tolerance to ensure the availability of suitable interferometric baselines (i.e., below half the critical baseline).

For wide–area surface change detection applications such as mapping of crustal deformations and ice motion, an interferometric capable ScanSAR beam mode will be used. For high–resolution InSAR applications such as land slide monitoring and glacier motion, the strip–map beam mode will be available.