

# **How to combine Sentinel-1 and TerraSAR-X for 3D Imaging Geodesy: Results for the Yarragadee Geodetic Observatory and the Australian CR Array**

The processing of spaceborne Synthetic Aperture Radar (SAR) range and azimuth measurements according to geodetic standards enables accurate observations of dedicated point targets (corner reflectors, CRs) across SAR missions with different frequencies. This approach, also called imaging geodesy, relies on precisely determined orbits and corrects the inconsistencies introduced by approximations in SAR image processing, the disturbances of atmosphere (path delays) and solid Earth tides in order to obtain consistent measurements. If these requirements are fulfilled, the range and azimuth measurements from different pass geometries can be jointly processed for the global 3D positions of the reflectors, which is even possible when using data of different SAR missions.

The TerraSAR-X mission (X-band, 9.65 GHz) operated by DLR is well known for its centimeter level measurement and positioning capability, but the combination with other missions becomes necessary if only small amount of data are available. ESA's Sentinel-1 mission (C-Band, 5.04 GHz) can achieve a similar observation quality, but is partly limited by the coarser resolution of the standard image product (Interferometric wide-swath product). However, this can be largely compensated by the larger amount of available Sentinel-1 data and therefore it makes sense to combine the measurements of both missions. We will demonstrate how this can be done in order to retrieve centimeter-level accurate CR coordinates based on our tests carried out in Australia.

During the past five years, Australia has considerably expanded its terrestrial SAR infrastructure. This infrastructure now offers a reflector array located in Queensland that consists of 40 trihedral CRs covering about 130 x 130 kilometers, as well as two trihedral CRs at the geodetic station of Yarragadee Geodetic Observatory in Western Australia. The CRs of both sites have accurate reference coordinates in the International Terrestrial Reference Frame (ITRF). The array has been surveyed with GNSS, whereas the CRs at Yarragadee have been integrated into the local station network by measuring the local ties, which makes them ideal testbeds for our imaging geodesy methods. The sites are regularly captured by Sentinel-1 and TerraSAR-X, which ensures sufficient amount of image data for the experiments. We will use the CRs at Yarragadee to confirm the consistency of both SAR missions and to demonstrate the combination method, and then assess the positioning on a larger scale by using the data from the Australian CR array.

## **Theme**

C2.06 Multi-frequency SAR exploitation synergy

## **Keywords**

SAR, Imaging geodesy, Positioning, Sentinel-1, TerraSAR-X

## **Presentation Type**

Oral

## **Satellite data used**

Sentinel-1, Other

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