

INTERNATIONAL CARTOGRAPHIC CONFERENCE 1995 (ICC'95)
ABSTRACT

Authors: Thomas W. Thompson, Howard A. Zebker,
Richard E. Carande, Paul A. Rosen, Soren N. Madsen,
Scott Hensley, Ernesto Rodriguez, Jakob J. van Zyl,
and Timothy W. Miller

Affiliation: Jet Propulsion Laboratory,
California Institute of Technology

contact: Thomas W. Thompson
Mail Stop 300-227
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena CA 91109

Phone Number: (818) 354-3881

Fax Number: (818) 393-5285

c-mail : thomas.w.thompson@ccmail.jpl.nasa.gov

Title: The NASA/JPL Aircraft Topographic Synthetic Aperture
Radar (TOPSAR) System for Rapid Production of Digital
Terrain Models

Category: Digital (cartography)

Abstract:

We have developed an aircraft radar interferometer, TOPSAR, that uses a synthetic aperture radar and interferometry to rapidly produce topographic maps of the earth. In some applications, this radar technique has the potential of replacing traditional photogrammetry which uses aerial photography. In other applications, this aircraft radar interferometer system can map areas inaccessible to aerial photography because of darkness or weather. Our aircraft radar is a precursor to a possible satellite system, which can produce a global digital topographic map of the earth.

We operate a C-band (6 cm wavelength) radar interferometer as an adjunct to the JPL Aircraft Synthetic Aperture Radar (AIRSAR) system that routinely acquires multi-polarization SAR images at P-band (70 cm wavelength), at L-band (25 cm wavelength) and at C-band. The TOPSAR/AIRSAR system flies on the DC-8 Airborne Laboratory operated by the NASA Ames Research Center. The TOPSAR system is implemented via two antennas mounted nearly vertically on the left side of the DC-8 aircraft with a 2.6 meter baseline spacing. Interferometric maps of the Surface are constructed by comparing the phase differences between SAR images from the two antennas. Statistical elevation errors for the TOPSAR system range from 1.0 meters for flat land to 3.0 meters for mountainous areas. Horizontal resolutions are 5 to 10 meters.

Typical data acquisitions are for areas of 10 km across-track (i.e. in range,) and up to 50 km along track (i.e. in azimuth). Analysis of radar data obtained in the Galapagos Islands (Islas Fernandina and Isabella) demonstrated that these 10 km-by-50 km topographic maps could be mosaicked together for an area of about 50 km-by-50 km. Also, one of us (SH) has recently demonstrated "repeat pass" interferometry where the phase-coherent SAR images were acquired from two separate, but nearly identical, aircraft flight paths. This "repeat pass" interferometry will use the L-band and P-band aircraft radar systems to acquire topographic maps at different radar wavelengths. We improved the TOPSAR aircraft radar system in 1994 by installing a new tightly-coupled Global Positioning/Inertia Navigation System (GPS/INS) unit. This improved our topographic data and enabled mosaicking via dead reckoning.

These aircraft observations are a precursor for a possible earth-orbiting TOPographic SATellite (TOPSAT), which is currently in premission studies at JPL. Current TOPSAT plans call for two nearly identical spacecraft that will be launched and operated in tandem. The L-band (25 cm wavelength) radar system on the TOPSAT two satellites will be able to acquire a global topographic map of the earth with height resolution of 2 to 5 meters for ground resolution pixels with sizes of 30 meters.