

RECOMMENDATION ITU-R RS.1749

**Mitigation technique to facilitate the use of the 1 215-1 300 MHz band
by the Earth exploration-satellite service (active) and the
space research service (active)**

(Question ITU-R 234/7)

(2006)

Scope

This Recommendation describes the mitigation technique of using filtering with Fourier transformation of the received signal. This technique applies to interference to synthetic aperture radars (SARs) in the 1 215-1 300 MHz band from other services with relatively small bandwidth. This Recommendation also provides typical parameters for spaceborne active sensors to be used in the development of additional mitigation techniques.

The ITU Radiocommunication Assembly,

considering

- a) that the 1 215-1 300 MHz band is allocated on a primary basis to the Earth exploration-satellite service (active);
- b) that this band is used by spaceborne synthetic aperture radars (SARs) which applications are to monitor, under all-weather and day and night conditions, deformation of the Earth's surface in most land areas, natural disasters, the environment, forests, land use, and others;
- c) that the 1 215-1 300 MHz band is also allocated to the radiolocation service on a primary basis, and to the radionavigation service on a primary basis in a certain number of countries;
- d) that Recommendations ITU-R SA.516 and ITU-R SA.1282 show that the operation of SARs is possible without harmful interference in the same frequency band as systems operating in the radiolocation service, including wind profiler radars, with the possible exception of radiolocation service systems using frequency-modulated pulsed radars;
- e) that performance and interference criteria of spaceborne active sensors are given in Recommendation ITU-R SA.1166;
- f) that air route surveillance radars (ARSRs) with higher isotropically radiated powers than the main beam powers of wind profiler radars have been in operation in this band for many years and harmful interference to spaceborne active sensor operations is normally not observed, although degraded performance is sometimes observed which may be attributed to ARSR transmissions,

recommends

- 1 that a mitigation technique applicable to the spaceborne active sensors as shown in Annex 1 could be used to reduce interference from radiolocation and radionavigation radar systems operating in the 1 215-1 300 MHz band to these sensors;
- 2 that typical parameters of spaceborne active sensors operating in the 1 215-1 300 MHz band given in Annex 2 should be used in the development of additional mitigation techniques.

Annex 1

Mitigation technique for interference to spaceborne SARs

1 Introduction

At some locations on Earth, bright lines appear in the images of the L-band Synthetic Aperture Radar/Japanese Earth Resources Satellite-1 (L-SAR/JERS-1). These bright lines are due to harmful radio frequency interference (RFI) from terrestrial radars. It has been shown that it is possible to eliminate the interference that causes these bright lines by conducting frequency analysis of the input data. The use of this technique will make it possible to resolve the current problem of RFI to SARs operating in the 1 215-1 300 MHz band.

2 Method and results

2.1 Method

The power level of the interfering signal is larger than that of the desired signal of the SAR as the interfering signal is a direct emission from the transmitter of terrestrial radars. So, when a Fourier transformation on the received signal is performed, the interfering wave components appear as spikes on the frequency axis. Focusing on these characteristics, as a pre-processing operation of range compression, we compare the power of each frequency “bin” with both the power spectra taken by Fourier transformation from the received signal and the original SAR signal (assuming that each component’s total power is equal to the desired component of the received signal) and 0 is adopted for the power of the specified frequency “bins” that have more power than expected (hereinafter referred to as “filtering”).

Furthermore, considering that the interference components that are not correlated with the SAR signal are suppressed by about 30 dB through range compression, and to prevent original signal loss, a 3 dB or more difference is adopted as the criterion between the desired signal and the interference in this case. When processed using longer time units, there is a tendency for spiked frequencies to scatter widely among the frequency spectrum and occasionally to result in the loss of the desired signal. For this reason, the received signal is divided into appropriate segments and then processed by methods such as Fourier transformation. (In this process, 1 024 azimuth lines are regarded as 1 segment.)

2.2 Interference suppression process

Specific procedures for the interference suppression process are as follows:

Step 1 : Divide received signal, including interference, into small segments

Signal of segment: S_r = received signal including interference, f_r = SAR reference signal (power adjusted with S_r)

Step 2 : Apply Fourier transformation to each segment

Transformed spectrum: $F(S_r)$, $F(f_r)$

Step 3 : Compare power in each frequency bin

Compare $|F(S_r)|$ to $|F(f_r)|$