Aerospace Remote Sensing using Synthetic Aperture Radar - From Basics to Applications

The interesting principle underlying the technique of aerospace synthetic aperture radar is to increase the resolution in azimuth direction by synthesizing a large aperture using a much smaller physical aperture in order to be carried aboard an airborne or space-borne platform. The principle has been found in the 50s of the last century but it is still indispensable for many applications.

In this lecture firstly the fundamental principles are explained from the imaging geometry to the data acquisition process and modes to the signal processing steps that are necessary to derive a two-dimensional focused image from prior acquired raw data. From the many algorithms available we will focus on the fundamental range-Doppler imaging algorithm which relies on a two-dimensional matched filter operation using a reference signal.

Furthermore some examples of data are shown and differences between optical images and synthetic aperture radar images are discussed focusing on the specific image properties of synthetic aperture images.

Several applications for synthetic aperture radar will be discussed making SAR attractive for day and night imaging independent of cloud cover. Some of them are traffic monitoring, disaster management, bio-and geophysical parameter extraction, change detection, surveillance and reconnaissance as well as many others.

Moreover some examples of air- and space-borne synthetic aperture radar systems will be shown and their properties discussed. Specifically examples of miniaturized systems with reduced size and weight in order to be carried on small platforms recently developed at Fraunhofer FHR will be addressed to show their relevance for unmanned aerial vehicles.

The lecture will close with an outlook of future perspectives of synthethic aperture radar which could be potentially the use of SAR in the automotive radar domain.