Recent advances in fully polarimetric Space-SAR sensor design and its applications

Invited Presentation

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With the un-abating global population increase our natural resources are stressed as never before, and the global day/night monitoring of the terrestrial covers from the mesosphere to the litho-sphere becomes all the more urgent. Microwave radar sensors are ideally suited for space imaging because those are almost weather independent, and microwaves propagate through the atmosphere with little deteriorating effects due to clouds, storms, rain, fog and haze. Globally humidity, haze and cloudiness are increasing at a rather rapid pace, whereas only 20 years ago all of those covered only 48% of the globe, today those have increased to about 62% and within another 20 years may exceed 80% for irreversible reasons. Thus, optical remote sensing from space especially in the tropical and sub-tropical vegetated belts will become rather ineffective, and microwave remote sensing technology must now be advanced strongly and most rapidly hand in hand with digital communications technology because operationally it is more rapidly available especially for disaster mitigation assistance.

The basic radar technologies to do the job are the multimodal Synthetic Aperture Radar (SAR) sensors, first developed for air-borne sensing implemented as for example in 1978 with the first space-borne digital Sea-Sat SAR which enjoyed great popularity and implementation until these days. However, the NASA Sea-Sat L-Band SAR had severe limitations in that it was of fixed wide swath-width at a single arbitrary polarization (HH) and of rather poor 25m resolution. In the meantime, fully polarimetric multi-modal high resolution SAR systems at multiple frequencies were introduced first with the multi-band AIRSAR of NASA-JPL culminating in the once-only pair of SIR-C/X-SAR shuttle missions of 1994 April and October, which laid the ground work for true day/night space remote sensing of the terrestrial barren and vegetated land and ocean covers using multi-band polarimetric SAR. Thereafter, NASA suspended further development of the basic need for further advancing airborne and space-borne multi-modal SAR imaging techniques except for SRTM shuttle mission of 2000 February; and swiftly the Canadian CCRS, the German DLR and the Japanese NASDA & CRL {now JAXA & NICT} took over introducing and steadily advancing the Convair-580, the E-SAR and Pi-SAR airborne highly advanced fully polarimetric sensors platforms, respectively.

These separate international multi-modal fully polarimetric and also interferometric SAR developmental efforts culminated in a well coordinated group effort of these three independent teams eventually launching and operating Fully Polarimetric Satellite SAR Sensors at L-Band (ALOS-PALSAR launched by JAXA/Japan in 2006 January), at C-Band (RADARSAT-2 launched by CSA-MDA in 2007 December) and at X-Band (TerraSAR-X launched by DLR-Astrium in 2007 July) with follow-on tandem missions soon to be realized. Thus, international collaboration on advancing day/night global monitoring of the terrestrial covers was demonstrated with the launch of the three fully polarimetric multi-modal SAR Satellites at L-, C-, X-Band, and its tandem satellite-pair updates are forthcoming very swiftly. All of this will be topped by the near-future joint DLR-JPL DESDynI/Tandem-L wide-swath, high-resolution fully polarimetric sensor implementation, which in due time will be enlarged to accommodate next to the

L-, C-, X- also P-Band sensors using one and the same reflector, then enabling full assessment also of dense tropical forests which will for example result in curtailing illegal deforestation, there and elsewhere.

In essence, we have created a silent watchful microwave eye in space assisting us in analyzing our biosphere in which we live or in other words microwave remote sensors are becoming the radiologists for providing input to the diagnosticists for assessing the health of Mother Earth. Without question, we will continue suffering from natural hazards, which are unavoidable as long life on Earth exists, but the resulting natural disasters are avoidable, and by discovering and assessing the hazards in time, will assist in mitigating the ensuing catastrophes due to these new microwave SAR sensors more than ever before for the benefit of sustaining the health of the biosphere in which we reside.

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