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A SMALL SATELLITE SENSOR FOR FOREST FIRE DETECTION

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Forest fires, resulting from both natural causes and human intervention, are very costly not only in lost property and resources but in the damage done to the environment. Early detection and location can help efforts to bring them under control and thus minimize the damage they cause.

A novel sensor for detection of forest and other large fires from a small satellite platform is described in this paper. The sensor can cover a swath up to 1000km wide on each orbit. Depending on coverage area, number of satellites and orbit, a low cost system with revisit time as low as 20 minutes can be deployed. The paper discusses some of these configurations.

The sensor is designed for small size, low power consumption and low weight, and is based on an uncooled infrared detector linear array with a compact optical system and a scanning mirror controllable in two axes. A possible scan pattern is a series of overlapping strips parallel to the orbital motion of the satellite, which allows a detector array of modest length (256 elements) to cover the full swath width with resolution of less than 1 Km. A typical fire with burning area extending over only some 20 x 20 m will be detected in clear conditions. Larger fires may be detectable even though covered by clouds.

Techniques used to maintain high sensitivity while preventing false alarms include proper selection of the wavelength band and on-board signal preprocessing.

The paper will describe the design of the sensor and sample architectures of the deployed system, and present an analysis of the expected performance.

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Title: Ground Processing of Altimeter Data based on Maximum Likehood Estimation Theory.

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The radar altimeter is a nadir looking radar able to evaluate with a high accuracy the time delay between the transmitted signal and the return echo from the surface, the echo leading edge slope (which depends on the height of the ocean waves) and the power level (which depends on target reflectivity). Following the ERS-1 mission, the RA-2 Radar Altimeter will be part of the ESA ENVISAT-1 mission. Compared with previous generation of altimeters, the RA-2 main improvements are constituted by on board capability to correct the propagation error due to the electron content of the ionosphere; by the on board tracking also over land regions, including the automatic selection of the best resolution to be used, by means of a novel tracking concept.

The extraction of the scientific information is completed on ground by applying a sophisticated estimation processing based on Maximum Likehood Estimation (MLE) theory to the received waveforms collected over open oceans.

This paper will review the architecture of the ground processor showing how the proposed algorithm has been derived from MLE theory: only few modifications have been required to keep the algorithm stable from the numerical point of view. It mainly consists of two successive set of repeat fittings (the first one required to get rough estimates and the second one to get high precision estimates of the parameters of interest) of a Reference echo model (based on the well known Brown model) to the samples of the waveform under analysis. Special care has been devoted to the evaluation of the maximum number of fittings to be executed on the single waveform in order to save computational time.

Performance in terms of accuracy achievable by this algorithm respect to the theoretical RAO-CRAMER bound has finally been investigated showing very good matching between simulation results and the theory.

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INTERACTIVE VISUALISATION OF EARTH OBSERVATION DATA IN A VIRTUAL ENVIRONMENT

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Over the last years, scientific visualisation has become an accepted tool for scientific researchers. However, in spite of the often three-dimensional nature of the data, current visualisation applications still rely to a great extent on traditional, two-dimensional, computer graphics techniques. The increasing number of information generating sources, as well as the increasing data density of these information sources will require the use of more advanced visualisation techniques if scientists want to continue examining these data in a useful way.

Remote sensing (RS) satellites have been identified as one of the major sources of huge amounts of scientific data. In 1991 ESA launched the Earth Remote Sensing satellite-1 (ERS-1). ERS-1 has a number of sensors among which the Synthetic Aperture Radar (SAR), the wind scatterometer (WSC), the radio altimeter (RA), and the along track scanning radiometer (ATSR). These sensors produce data of very different nature. Many geophysical parameters can be obtained from these sensors. To name a few: sea surface temperature (RA), sea surface winds (WSC), and mean sea surface (RA). In the future, satellites like the ERS-2 and ENVISAT will add many new sensors to this list. This will dramatically increase the amount of information available about our planet. It is a challenging task for scientists to translate this information to products which can be used by end-users of remote sensing data. For instance, comparing RS data with either data from other sources or with other RS data might provide new insights in their relations. From this knowledge new applications for RS data can be generated. Especially with the outlook of many more RS sensors to come and the massive amount of data related with that, the need for good visualisation tools is stronger than ever. Virtual Environments (VEs) are very promising tools to perform this type of data fusion in an intuitive manner.

Currently, TNO-FEL is developing a prototype system for ESA/ESTEC, which employs VE technology, for the interactive visualisation of remote sensing data. The aim of the prototype is provide a "quick-look" tool for the remote sensing user community. The system facilitates the interactive visualisation of multiple large remote sensing datasets from different sources, as well as remote sensing datasets in relation with data originating from other sources, e.g., terrain data from geographic information systems. The prototype contains a set of functions that allow the user to visualise a number of data products from ERS-1 and SPOT, both from imaging and non-imaging sensors. All RS data can be combined with other RS data, or with digital elevation models (DEMs), e.g., from the Digital Land Mass System (DLMS) database, where appropriate.

The VE based user interface provides stereoscopic visualisation and intuitive user control over all data manipulation and rendering functions The user can select (multiple) datasets to be visualised and controls the type of rendering operations. Attributes added to the data can be selected for visualisation to improve classification. The position of the observer in the virtual database world and his viewing direction are taken into account in the generation of stereoscopic images in order to provide a sense of "immersion" of the user in the RS data. Manipulation of the viewing parameters offers scaling and zooming in on details of the data. The user may interactively select the required level of detail of the visualised data set. Together these functions allow the user to concentrate on exploring the contents of the data in an intuitive way.

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Advanced SAR Focusing Algorithm Implementation on Massive Parallel Computer System (QUADRICS)

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ABSTRACT

Recently new computer architerctures, based on massive parallel data processing, have been strongly developed together with proper operative systems and hi-level programming languages.

Alenia Spazio have developed a proprietary technology for advanced computer system, Quadrics project, which performs several tens of GFLOPs.

As applicative example, an high quality SAR focusing processor has been implemented and is in testing phase. The proposed algorithm belongs to "chip scaling" class and performs very well also with high squint angle and/or rapid Doppler Centroid variations.

The paper describes the Quadrics technology and the fundamental of SAR processing algorithm used with test reports.

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BOOK OF ABSTRACTS

Abstracts have been arranged in chronological order according to the letter and number appearing on the abstract.
The abstracts begin with the IAF, followed by the IAA and IISL.

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