A Review on Flooded Area Detection Technique Using Multitemporal SAR Images

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***Abstract*— The problem of detection of flooded areas from multitemporal SAR images is addressed here. Different image processing methods for synthetic Aperture Radar (SAR) images have been presented in order to identify flooded areas after a flood event. Multitemporal image analysis methods are applied to a pair of SAR images, acquired on the same area at different times. SAR calibration is a very complex and sensitive problem; some errors may persist after calibration that interferes with subsequent steps in the data fusion and visualization process. "Cross-calibration/normalization," method is proposed to solve this problem. This, in turn, facilitates image enhancement and the numerical comparison of different images with data fusion and visualization processes. The proposed processing chain includes filtering, histogram truncation, and equalization steps applied in an adaptive way to the images. Fast-ready flooded maps have been generated by an RGB composition that is able to enhance the changes occurred. Pre-flood and post-flood images are combined into a color image to better identify the flooded areas in comparison with permanent water and other classes. "Fast-ready flood map," are very quickly and automatically generated without user interaction to support the authorities in providing first aid to the population.**

Keywords*— Flood detection, image enhancement, multitemporal synthetic aperture radar (SAR) imagery, RGB composition.

I. INTRODUCTION

Several countries experience fatalities, injuries, property damage, economic and social disruption resulting from natural disasters such as earthquakes, hurricanes, floods, volcanic eruptions. The interest in monitoring weather events is continuously increasing because of the numerous disasters occurred in the recent years in many countries. Radar images are typically best data for flood detection. Several studies demonstrated that Synthetic Aperture Radar (SAR) systems represent powerful tools for flood mapping because SAR can observe the Earth's surface during daytime and nighttime and even in cloudy conditions. The approach proposed here allows examining the affected areas to assess the damages, for providing first aid to the population and to plan for rescue operation. Multitemporal SAR images are very useful source of information for large amount of applications, especially for change detection and monitoring.

Timely and accurate change detection of Earth's surface features is important for understanding relationships and interactions between human and natural phenomena. Detecting the changes in the images of the same scene taken at different times has interested researchers to a large number of applications.

Synthetic Aperture Radar (SAR) sensors are optimally suited for providing reliable information on extensive floods, which provides the information even under rainy or at least cloudy conditions. Flood information is needed as quickly as possible to provide an overview of the situation and to improve the crisis management and response activities.For the purpose of flood risk and flood damage assessment, other flood related parameters than flooded area such as inundation depth and flood duration are required. Since these parameters cannot be derived directly from satellite data, additional information has to be included.

Multitemporal SAR data from the same area at different times are particularly useful for investigating damage. The changes exhibited by an image pair can be identified to generate an overall understanding of the phenomenon, which in turn can help relevant authorities to provide first aid and other assistance to the general population. Unlike in damage assessments and disaster prevention using satellite data, a very rapid response is mandatory in emergency situations.

Here a novel image preprocessing chain is proposed together with methods of data fusion and rendering for multitemporal images. The pre-event and post-event images are combined into a color composite image to better indicate the changes, integrating different information sources into a single display. This is referred to as the "fast-ready flood map". This is a flood picture generated automatically and very rapidly without any user interaction for use by the authorities.

II. LITERATURE REVIEW

The importance and timeliness of the multitemporal data provided by the numerous remote sensing satellites that orbit around our planet is done by Lorenzo Bruzzone [1]. These data are captured by different kinds of sensors (e.g., synthetic aperture radar (SAR) sensors) and have different geometrical properties. The temporal component, integrated with the spectral and the spatial dimensions, allows the analysis of land-cover dynamics revealing complex and important patterns that concerns with applications connected to environmental monitoring. However, the use of the temporal domain further increases the complexity usually associated with the processing of single-date remote sensing images.

Luciano Alparone [2] presents a novel multi-sensor image fusion algorithm, which extends pan-sharpening of

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multispectral (MS) data through intensity modulation to the integration of MS and SAR imagery. The method relies on SAR texture, extracted by ratioing the despeckled SAR image to its low pass approximation. SAR texture is used to modulate the generalized intensity (GI) of the MS image, which is given by a linear transform extending Intensity-Hue-Saturation (IHS) transform to an arbitrary number of bands.

Semi-automatic flood extraction procedures based on change detection techniques is presented by Andreoli Remi [3]. This particularly adapted to plain flood monitoring and mapping. The change detector was specifically elaborated to analyze ENVISAT ASAR Wide Swath Mode data pairs, which appear very well adapted to flood monitoring over wide areas. This semiautomatic flood extraction procedure, using SAR adapted change detection techniques, are defined by the linear change detection methods, such as ratioing. However, change detection between data with different polarizations is not fully validated.

Karl Krissian [4] describes the derivation of Speckle Reducing Anisotropic Diffusion (SRAD), a diffusion method tailored to ultrasonic and radar imaging applications. SRAD is the edge-sensitive diffusion for speckled images. This involves showing that the Lee and Frost filters can be cast as partial differential equations, and then deriving SRAD by allowing edge-sensitive anisotropic diffusion within this context. Just as the Lee and Frost filters utilize the coefficient of variation in adaptive filtering; SRAD exploits the instantaneous coefficient of variation, which is shown to be a function of the local gradient magnitude and Laplacian operators.

The availability of Synthetic Aperture Radar (SAR) data offers great potential for environmental monitoring due to the insensitiveness of SAR imagery to atmospheric and sunlight-illumination conditions are done by G. Moser [5]. In addition, the short revisit time provided by future SAR-based missions will allow a huge amount of multitemporal SAR data to become systematically available for monitoring applications. The problem of detecting the changes that occurred on the ground by analyzing SAR imagery is addressed by a completely unsupervised approach, i.e., by developing an automatic thresholding technique.

III. SYSTEM ARCHITECTURE

The different processing steps involved in the generation of the flood maps. The overview for the proposed system is shown in Fig.1.,

- Input Image

Synthetic-Aperture Radar (SAR) is a form of radar whose defining characteristic is its use of relative motion, between an antenna and its target region, to provide distinctive long term coherent-signal variations that will be exploited to obtain finer spatial resolution than is possible with conventional beam-scanning means. SAR images have wide applications in remote sensing and mapping of the surfaces of both the Earth and other planets.

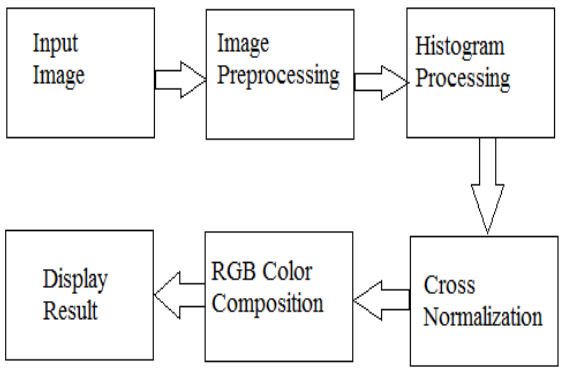

Fig.1. Overview of proposed system

- Image Preprocessing

Speckle noise is a granular noise that inherently exists in and degrades the quality of the SAR images. It is caused by coherent processing of backscattered signals from multiple distributed targets. Filtering will helpful to remove the speckle noise present in the images. Several methods are used to eliminate the speckle noise, based upon different mathematical models of the phenomenon.

- Histogram Processing

An image histogram is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance.

- Cross-calibration/ Image-normalization

During Cross-Calibration/Image Normalization, the equalization process will helpful because it allows us to match all of the temporal channels to a unique, uniform, reference model, normalizing the different histogram distributions of the images. The aim will be to match every processed image to the uniformly distributed image as well as possible by avoiding information loss and obtaining similar dynamics for all of the images.

- RGB composition of multitemporal SAR images

When the temporal pair of images will be preprocessed, the images can be used to create the RGB composition. A multitemporal sequence of images will be combined, so that different colors identify flooded, dried, no-flooded areas and permanent water.RGB composition will used as a preliminary step before a change detection process which will helpful to map flooded areas along rivers. The color composite technique will use with radar imagery relies upon basic principles related to surface roughness or smoothness and changes in the backscattering signal intensity of the surface conditions. A rough surface will have a high radar backscatter coefficient value and will therefore tend to be bright, whereas a smooth surface will tend to be dark because of its low backscatter coefficient value resulting from a rather specular reflection response. Thus, changes in surface conditions will result in changes in colors from basic red (R), green (G), blue (B) to a resulting combination (yellow, cyan, and magenta).

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IV. CONCLUSION

This paper presents a review of the flooded areas detection using multitemporal SAR images. Here, cross normalization of the multitemporal images can be used for the identification of flooded areas gives a novel method to identify flooded area independent of acquisition parameters. The RGB composition will make it easier to identify the changes that have been occurred between the two acquisition dates. This paper provides an efficient way of identifying the flood affected areas.

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