



## Combination of land surface temperature with flooding area detection wireless system

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*Abstract— Flooding is a recurrent and dramatic natural disaster that affects several areas in the world, both in tropical and temperate regions, often causing great damages to lives and property, industrial settlements, infrastructures, artistic and historical sites, aside from dramatically affecting local ecosystems. It is expected that the frequency of these phenomena will increase in the next future, due to climate change and the occurrence of several extreme weather events. Accurate knowledge of flood extents is crucial to improve disaster management and to mitigate the impact of flood episodes, during both the emergency phase, when an overall view is needed in order to plan relief efforts, and the aftermath, for the assessment of damaged areas. The addition based on the SAR images collected at regular intervals and the comparison are made and analyzed. Using feature extraction process that creates meaningful sequential time series that can be analyzed and processed for change detection. In addition, the Enhanced Fuzzy C-Means (E-FCM) approach is used to cluster the various types of sub image details. The method was evaluated on real and simulated land cover change examples are and obtained according to more change detection accuracy.*

### INTRODUCTION

Remote sensing data of affected areas, together with effective methods to exploit their information, can be particularly useful in the damage estimation phase: they offer a synoptic overview of wide areas, giving a snapshot of the extents of the flooding event. In this research study analysis a statistical model able to perform flood detection by using information and data fusion. It is based on Bayesian Networks (BNs), is one of the most common types of Probabilistic Graphical Models (PGMs) combining Probability Theory (PT) and Graph Theory (GT), which introduce graph structures into a probabilistic model to represent dependence assumptions among the involved variables.

BNs are a statistically well-founded method to combine imagery information with ancillary data, such as distance from the river, Digital Elevation Models (DEMs), Hydraulic Models, etc., This combination is not restricted to a specific sensor, and it can exploit the information.

In this study describes a Bayesian network and to integrate remotely sensed data, such as multi-temporal SAR intensity images and interferometric-SAR coherence data, with geomorphic and other ground information. The methodology is tested on a case study regarding a flood that occurred in the Basilicata region (Italy), monitored using a time series of COSMO-SkyMed data sets. It is shown that the synergetic use of different information layers can help to detect more precisely the areas affected by the flood, reducing

false alarms and missed identifications which may affect algorithms based on data from a single source images.

In this proposed system natural hazards research requires dealing with several uncertainties that arise from limited process knowledge, measurement errors, censored and incomplete observations, and the intrinsic randomness of the governing processes. Nevertheless, deterministic analyses are still widely used in quantitative hazard assessments despite the pitfall of misestimating the hazard and any ensuing risks. In this study show that Bayesian networks offer a flexible framework for capturing and expressing a broad range of uncertainties encountered in natural hazard assessments. Although Bayesian networks are well studied in theory, their application to real-world data is far from straightforward, and requires specific tailoring and adaptation of existing algorithms.

The proposed study offer suggestions as how to tackle frequently arising problems in this context and mainly concentrate on the handling of continuous variables, incomplete data sets, and the interaction of both. By way of three problem analysis from earthquake, flood, and landslide research demonstrate the method of data-driven Bayesian network learning, and showcase the flexibility, applicability, and benefits of this approach.

### RELATED WORK

In the “Near real-time flood detection in urban and rural areas using high resolution synthetic aperture radar images ” [10] paper describe a near real-time flood detection algorithm giving a synoptic overview of the extent of flooding in both urban and rural areas, and capable of working during night-time and day-time even if cloud was present, could be a useful tool for operational flood relief management. The paper describes an automatic algorithm using high resolution Synthetic Aperture Radar (SAR) satellite data that builds on existing approaches, including the use of image segmentation techniques prior to object classification to cope with the very large number of pixels in these scenes.

Flood detection in urban areas is guided by the flood extent derived in adjacent rural areas. The algorithm assumes that high resolution topographic height data are available for at least the urban areas of the scene, in order that a SAR simulator may be used to estimate areas of radar shadow and layover. The algorithm proved capable of detecting

flooding in rural areas using TerraSAR-X with good accuracy, and in urban areas with reasonable accuracy. The accuracy was reduced in urban areas partly because of TerraSAR-X's restricted visibility of the ground surface due to radar shadow and layover.

The latest generation of very high resolution Synthetic Aperture Radar (SAR) satellites now make such technology possible. A near real-time algorithm might allow the emergency services to view the geo-registered flood extent at very high resolution over the whole area overlaid on a base map a few hours after overpass. This could be difficult to achieve by other means.

In the **"Probabilistic graphical models for flood state detection of roads combining imagery and DEM"** [22] paper describe a new system for estimating the state of roads during flooding based on probabilistic graphical models is presented.

The location of the roads is given by a geographic information system whereas the up-to-date information for the assessment of flood state is delivered by remote sensing data. Furthermore, the height information from a Digital Elevation Model (DEM) is combined with image data to improve the accuracy of the results.

The presented system is based on factor graphs, which are used to model the statistical dependence between random variables. Three different models are presented: a 1-D pixel-based model, a 2-D topology-based model considering the dependences of neighboring pixels, and a 3-D multitemporal-based model, which can deal with sequential remote sensing imagery at several points in time. The proposed models are compared to a flood simulation based only on the DEM and a maximum likelihood classification based only on the image data. A numerical evaluation demonstrates the improved performance of the three proposed models.

The manual interpretation of imagery during natural disasters is difficult and, most importantly, time consuming. Therefore, near real time automatic or semiautomatic image analysis methods have to be developed, which enable the interpretation of infrastructure objects that are relevant for rescue teams. Derived floodplains from remote sensing images demonstrate good performance if the flooded areas are not occluded by vegetation, clouds or shadows.

In case of flooding also the Digital Elevation Model (DEM) can be used to detect the flood state of infrastructure (referred to as DEM simulation). However, simulations based only on DEM to detect the floodplain lead to correct assignments between only 60% and 80% depending on the resolution and the model. The goal of this letter is the development of a system which combines the approaches by exploiting the information of DEM at locations where imagery does not provide accurate information due to occlusions.

The image analysis method has to fulfill several requirements. First, the method has to comply with high demands on the semantic correctness. Second, the computation time has to be near realtime. Third, the method has to be flexible with respect to input data. In this letter, they present a method to detect the flood state of roads based on probabilistic graphical models, which fulfills these requirements and facilitates the combination of remote sensing data with height information from DEM.

In the **"A new method for cross-normalization and multi-temporal isualization of SAR Images for the detection of flooded areas"** [1] paper describe a multi-temporal Synthetic Aperture Radar (SAR) images are available, precise calibration and perfect spatial registrations are required to obtain a useful image for displaying changes that have occurred. 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. Because of the strong histogram asymmetry of SAR images, due to the well-known non-Gaussian model of radar backscattering, traditional image preprocessing procedures cannot be used here. A novel specific preprocessing phase, the so-called cross-calibration/normalization is proposed to solve this problem. This, in turn, facilitates image enhancement and the numerical comparison of different image takes together 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 in question. The design of the method and the experimental procedure is based on images from the Italian Cosmo/Skyimed mission. Both Strip map and Spotlight images are taken into account to test the algorithms at different spatial resolutions. This paper also presents an example application: the generation of a single flood picture, the so-called —fast-ready flood map from multi-temporal SAR images.

The maps are very quickly and automatically generated without user interaction to support the authorities in providing first aid to a population. Toward this end, RGB composition is used: 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. Earth observation technologies are very important in hazard monitoring. In particular, Synthetic Aperture Radar (SAR) acquisitions play a decisive role in this context thanks to their all-weather capability. Multi-temporal data from the same area at different times are particularly useful to those investigating damage.

The changes exhibited by an image pair can be identified to generate an overall understanding of the phenomenon in question, 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. Multi-temporal analysis is only possible if the pair of images is radiometrically and spatially accurately registered. Thus, an extremely precise calibration or the cross-normalization of multi-temporal images is required to facilitate the subsequent processing steps. In this paper, a novel image preprocessing chain is proposed together with methods of data fusion and rendering for multi-temporal images.

In the “**COSMO-SkyMed an existing opportunity for observing the earth**” [39]” paper describe a constellation of small Satellites for Mediterranean basin Observation (COSMO-SkyMed) is the largest Italian investment in Space Systems for Earth Observation, commissioned and funded by Italian Space Agency (ASI) and Italian Ministry of Defence (MoD). COSMO-SkyMed is a Dual-Use end-to-end Earth Observation System aimed at establishing a global service supplying provision of data, products and services compliant with well-established international standards and relevant to a wide range of applications, such as Risk Management, Scientific and Commercial Applications and Defence Applications. The system consists of a constellation of four LEO mid-sized satellites, each equipped with a multi-mode high-resolution SAR operating at X-band.

COSMO-SkyMed is the first Italian dual Space System dedicated to the Earth Observation. COSMO-SkyMed is the largest Italian investment in Space Systems for Earth Observation, commissioned and funded by Italian Space Agency (ASI) and Italian Ministry of Defence (MoD). It is a Dual-Use end-to-end Earth Observation System aimed at establishing a global service supplying provision of data, products and services compliant with well-established international standards and relevant to a wide range of applications, such as Risk Management, Scientific and Commercial Applications and Defence Applications. ]

## EXISTING SYSTEM

Flooding is a recurrent and dramatic natural disaster that affects several areas in the world, both in tropical and temperate regions, often causing great damages to lives and property, industrial settlements, infrastructures, artistic and historical sites, aside from dramatically affecting local ecosystems.

The presence of many land cover types, each one with a particular signature in the presence of flood, requires modeling the behavior of different “objects” in the scene which is not necessarily associated to land cover categories in order to associate them to flood or no-flood conditions.

Recently the data mining community’s attention was brought to a fundamental limitation of the clustering of subsequences that were extracted with a sliding window from a time series.

The sliding window causes the clustering algorithms to create meaningless results as it forms sine wave cluster centers regardless of the data set, which clearly makes it impossible to distinguish one dataset’s clusters from another.

This is due to the fact that each data point within the sliding window contributes to the overall shape of the cluster center as the window moves through the time series. This limitation was illustrated by using data sets from various fields, i.e., stock market and random walk data sets.

There are two general approaches to classification that can be applied to time series data, namely supervised and unsupervised. The supervised approach requires initial training on labeled pixels according to their land cover type.

## LIMITATIONS OF EXISTING SYSTEM

The existing systems have the following limitations,

- The combined analysis of multi-temporal SAR intensity and coherence trends has been proposed to detect flooded areas, reducing false alarms and missed identifications which affect algorithms based on SAR intensity alone.
- The supervised approach must also be robust to errors occurring within the training sets.
- Generating training data at global and regional scales is a very labour-intensive and costly endeavor.
- K-Means Clustering algorithm is used for clustering the image segments.
- Precision factor and iteration count for fuzzy image segmentation cannot be given as input.
- Objects size is not taken into consideration and so very small negligible area is also treated as vegetation land if color information matches.

## PROPOSED SYSTEM

Proposed statistical model able to perform flood detection by using information and data fusion. It is based on Bayesian Networks (BNs), one of the most common types of Probabilistic Graphical Models (PGMs) combining Probability Theory and Graph Theory, which introduce graph structures into a probabilistic model to represent dependence assumptions among the involved variables. The proposed

method is quite general and can be considered as a particular case of a general “class” of BNs, in which  $M$  conditional independent imagery sources and  $N$  independent ancillary data can be considered. The BN structure thus provides information about the underlying processes and the way that various variables communicate and share “information” as it spreads around the network. The proposed system includes time series based land cover change detection based on sequence of image collection. Threshold based Fuzzy C-Means (FCM) Clustering is used for clustering so with different cluster value and iteration count values, the same image can be viewed and analyzed in different views. In addition with land nature change in the given location, the wild animal movements are also tracked using this thesis. Based on the time intervals, the images are played as frames. This will track the animal locations easily. Likewise, for long time period gap, the change in land nature is also tracked. For example, if times frames are in months, then the land is cultivated or not is also identified.

### ADVANTAGES OF PROPOSED SYSTEM

The proposed system has the following advantages,

- It will be helpful in clustering the image segment even in changing climatic conditions over time.
- It is also capable of describing the dynamics of the flooding event.
- Precision factor and iteration count for fuzzy image segmentation are given as input. Objects size are taken into consideration and so very small negligible area is not treated as vegetation land even if color information matches.
- The proposed system gives the statistical data such as number of objects (i.e., vegetation land types) found and percentage of area covered. Chart options are also provided to show the statistical information.

### CONCLUSION

Currently, Images need to be selected and given for land change detection. In future, the application can monitor a large dataset and whenever a new image is updated, then segmentation takes place automatically and land change nature identification could be made and alerted in any change. Also the system could be enhanced to monitor the wild animal movements over the land areas. Further it is enhanced with the performance of the self organization map with the user defined to find the flooding areas in the bayesian network.

In addition, the research could be enhanced by considering the introduction of other variables, such as imagery by optical sensors or other ancillary information. In

this respect, another advantage of the BN representation could be exploited that is its modularity. In fact, depending on the independence relations between new and old variables and some local probability models could be reused, and only some conditional probability terms would need to be inserted in the computation without rewriting the whole joint probability.

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