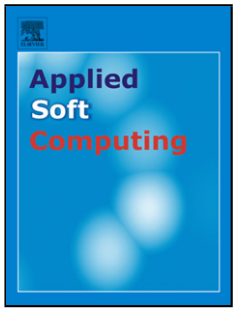

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PII: S1568-4946(17)30300-9
DOI: http://dx.doi.org/doi:10.1016/j.asoc.2017.05.037
Reference: ASOC 4241

To appear in: *Applied Soft Computing*

Received date: 30-9-2016
Revised date: 27-4-2017
Accepted date: 20-5-2017

Please cite this article as: Mohammad Mahdi Kamani, Farshid Farhat, Stephen Wistar, James Z. Wang, Skeleton Matching with Applications in Severe Weather Detection, *<![CDATA[Applied Soft Computing Journal]]>* (2017), http://dx.doi.org/10.1016/j.asoc.2017.05.037

Skeleton Matching with Applications in Severe Weather Detection

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Abstract

Severe weather conditions cause an enormous amount of damages around the globe. Bow echo patterns in radar images are associated with a number of these destructive conditions such as damaging winds, hail, thunderstorms, and tornadoes. They are detected manually by meteorologists. In this paper, we propose an automatic framework to detect these patterns with high accuracy by introducing novel skeletonization and shape matching approaches. In this framework, first we extract regions with high probability of occurring bow echo from radar images and apply our skeletonization method to extract the skeleton of those regions. Next, we prune these skeletons using our innovative pruning scheme with fuzzy logic. Then, using our proposed shape descriptor, *Skeleton Context*, we can extract bow echo features from these skeletons in order to use them in shape matching algorithm and classification step. The output of classification indicates whether these regions are bow echo with over 97% accuracy.

Keywords: Radar image, severe weather forecasting, skeleton pruning, fuzzy logic, big data analytics

1. Introduction

Monitoring and storing climatic data around the globe provide a vast amount of data for weather condition analysis. In spite of the fact that computational power is emerging continuously, automatic severe weather forecasting is costly and not always accurate. Meteorologists leverage various and complex models to forecast storms using data from a collection of sensors, including tools and data at the Storm Prediction Center (SPC) of the National Oceanic and Atmospheric Administration (NOAA). The data gathered from these sensors are stored historically; hence it can be leveraged to extract historical patterns of different severe weather conditions. Although meteorologists have developed numerous and complicated models for forecasting storms, they still rely significantly on their interpretations instead of automated algorithms. Further, the majority of these models depend on initial conditions and are highly sensitive to noise, making forecasting difficult. Therefore, it is inevitable for this field to combine big data, computer vision, and data mining algorithms with these models to seek faster, more robust, and more accurate results.

Severe weather conditions consist of thunderstorms, tornadoes, floods, lightning, hail, and strong winds. Each of these conditions are investigated widely in meteorological literature, and they need different sources for detection and

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