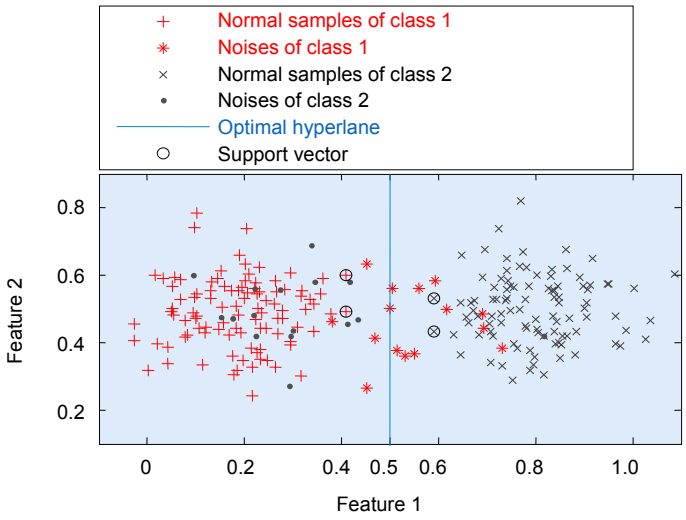
OEE | Overview

DOI: 10.3969/j.issn.1003-501X.2017.09.003

Convective clouds detection in satellite cloud image using fast fuzzy support vector machine

Fei Gong [1]*, Wei Jin[1], Wenzhe Tian[1], Randi Fu[1] and Caifen He[2]

[1]Faculty of Electrical Engineering and Computer Science, Ningbo University, Ningbo 315211, China;
[2]Zhenhai District Meteorological Bureau, Ningbo 315202, China



Simulation sample-set contains two kinds of incompletely separable samples.

Abstract: Satellite cloud image processing is widely used in meteorology, and convective cloud attracts great attentions in meteorological monitoring. Generally speaking, convective cloud plays a pivotal role in governing the rainfall, and they are also responsible for modulating the radiation budget of earth atmosphere system. Especially, the emergence of cumulonimbus which generates at the beginning of convection is often indicating thunder and lightning, torrential rains or even accompanies typhoons and other natural disasters. Hence, the convective clouds detection is a key factor for weather forecasting, climate monitoring and helps to prevent natural disasters.

In this paper, a modified Support vector machine (SVM) was proposed to detect convective clouds. The traditional SVM is easily affected by noises and outliers, and its training time will dramatically increase with the growing in number of training samples. On the other hand, satellite cloud image may easily be deteriorated by noises and intensity non-uniformity with a huge amount of data needs to be processed regularly, so it is hard to detect convective clouds in satellite image using traditional SVM. To deal with this problem, a novel method for detection of convective clouds based on a fast fuzzy support vector machine (FFSVM) was proposed. FFSVM was constructed by eliminating feeble samples and designing new membership function as two aspects. First, according to the distribution characteristics of fuzzy inseparable sample-set and the fact that the classification hyper-plane is only determined by support vectors, this paper uses SVDD, Gaussian model and border vector extraction model comprehensively to design a sample selection method in three steps, which can eliminate most of redundant samples and keep possible support vectors. Then, by defining adaptive parameters related to attenuation rate and critical membership on the basis of the distribution characteristics of training set, an adaptive membership function is designed. Finally, the FFSVM was trained by the remaining samples using adaptive membership function to detect convective clouds. The experiments on FY-2D satellite images show that the proposed method, compared with traditional FSVM where no samples were eliminated, not only remarkably reduces training time, but also further improves the accuracy of convective clouds detection.

Keywords: fuzzy support vector machine; sample elimination; adaptive membership function; detection of convective clouds

Citation: Gong Fei, Jin Wei, Tian Wenzhe, *et al.* Convective clouds detection in satellite cloud image using fast fuzzy support vector machine[J]. *Opto-Electronic Engineering*, 2017, **44**(9): 872–881

See page 872 for full paper.