DISSERTATION OF

Review of neighbourhood rough set based band selection techniques for classification of hyperspectral images

A project report submitted in partial fulfilment of the requirements for the award of

the degree of

MASTER OF COMPUTER APPLICATION IN CLOUD TECHNOLOGY AND INFORMATION SECURITY

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Int.MCA(CTIS) 9th Semester

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Program of Cloud Technology & Information Security

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CERTIFICATE FROM GUIDE

This is to certify that the project work entitled "Review of neighbourhood rough set based band selection techniques for classification of hyperspectral images" has been carried by **Aparna Bhattacharjee (ADTU/2018-23/ICA/010) and Kanika Rabha (ADTU/2018-23/ICA/003)** of **9th semester Int.MCA** in Cloud Technology & Information Security under my guidance. This work has not been submitted to any other institution in any form. I hope this project will help them in their future.

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CERTIFICATE FROM EXAMINERS

This is to certify that **Aparna Bhattacharjee (ADTU/2018-23/ICA/010) And Kanika Rabha (ADTU/2018-23/ICA/003)** of **9th semester Int.MCA** in Cloud Technology & Information Security have undergone their project work entitled "Review on neighbourhood rough set based band selection techniques for classification of hyperspectral images" under the program of Computer Science & Science & Engineering.

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DECLARATION BY STUDENT

We hereby declare that the project work entitled "Review of neighbourhood rough set based band selection techniques for classification of hyperspectral images" is hereby accorded for 9^{th} semester under the program of Cloud Technology and Information Security, Assam Downtown University in record of our own work carried out as a pre-final year project, under the guidance of **Dr. Barnali Barman**, Assistant Professor, Department of Computer Science & engineering.

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ABSTRACT

Hyperspectral images typically contain hundreds of contiguous spectral bands, allowing for precise differentiation of spectrally similar classes. Band selection is a well-known method for reducing hyperspectral data dimensionality.

It is an effective way to reduce the size of hyperspectral data and to overcome the curse of dimensionality problem in the classification. A robust mathematical tool for dealing with ambiguous and uncertain data is neighbourhood rough set, a variant of rough set capable of assessing continuous values.

In this project, we have surveyed that the authors have presented four forward greedy hyperspectral band selection algorithms with the help of neighbourhood rough set, the variable precision neighbourhood rough set.

CONTENT

INTRODUCTION

1.1 OVERVIEW OF THE PROJECT:

Hyperspectral imaging has now become a research hotspot as it is widely used in many fields, that utilizes digital imaging and spectral measurement [1,2]. Hyperspectral imaging is an emerging method that enhances the capacity of multispectral image analysis [3]. It facilitates quick material recognition , tracing and separation based on differences in biological , chemical or physical properties and provides valuable information for the classification of a variety of materials [4]. For better identifying, describing, and categorizing land-cover objects, hyperspectral sensors collect the radiance of the earth's surface materials in hundreds of narrow and continuous spectral bands [2]. It gathers hundreds of images for the same spatial area at various wavelengths. However, such high dimensional includes highly associated and insignificant information resulting in the curse of dimensionality [5]. Hyperspectral imaging measures the continuous spectrum of the light for each pixel of the scene with fine wavelength resolution, not only in the visible but also in the near-infrared, in contrast to the human eye's three color receptors (blue, green, and red). Hyperspectral imaging has many benefits over traditional RGB imaging, including the ability to detect minute components and the presence of spatial, spectral, and multi-constituent information [4]. Rich spectral information in hyperspectral data offers the potential for more precise land form detection, identification, and classification [6].

The dimensionality of HSI has been reduced using two conventional techniques called feature extension and feature selection. The feature selection method selects the most informative subset of spectral bands. This paper primarily focuses on feature (band) selection methods that maintain the acquired spectral channels' original physical details [1]. In order to find a band subset that retains the majority of the original data's characteristics, feature selection is used. However, this method is time-consuming and inevitably results in the loss of significant amounts of information. Instead, feature extraction works better for this purpose [2].

A paradigm for dealing with ambiguity, vagueness, and incompleteness in data is called rough set theory [5]. The rough set (RS) theory put forth by Pawlak broadens the application of set theory to the study of information systems with sparse and imperfect data. Rough set theory (RST) addresses incompleteness, ambiguity, and imprecision in data sets. The concept of lower and upper approximation is used to eliminate redundant features. In the pattern recognition literature, there are quite a few feature selection methods based on RST [3,4]

1.2 MOTIVATION:

The motivation is to review recent progress in this particular topic. It is to summarize the current state of knowledge of this topic. To create an understanding of the topic for the reader by discussing the findings presented in recent research papers.

1.3. OBJECTIVE:

The objective of this project is to Review Study of neighbourhood rough sets based band selection techniques for classification of hyperspectral images.

Literature Review:

Publication Year	Author	Paper Name	Summary
2016	Yao Liu, Hong Xie, Kezhu Tan, Yuehua Chen, Zhen Xu and Liguo Wang	Hyperspectral band selection based on consistency-measure of neighborhood rough set theory	The consistency function is a contribution that this study makes to the NRS theory, and a supervised band-selection approach is proposed as a result of this work. Using this strategy, They determined the relative significance of each band. The most informative band subset was constructed by selecting, from the primary dataset, the bands that had the most significant values and using those bands. A forward greedy search method that was based on the consistency function was developed for the purpose of band selection. They compared the DMNRS band-selection method with the algorithm that was proposed and analyzed the differences between the two. According to the findings, the suggested method is able to locate band subsets for values of within the range [0, 1], while the DMNRS approach is only able to locate band subsets when is greater than 0.3.
2016	Yao Liu, Hong Xie, Liguo Wang, and Kezhu Tan	Hyperspectral band selection based on a variable precision neighborhood rough set	In this work, a band-selection method based on variable precision neighbourhood rough set theory to select informative bands from hyperspectral images is proposed. The VPNRS theory was used to calculate the dependence and importance of each hyperspectral band. For band reduction, a forward greedy searching algorithm based on VPNRS was implemented.
2013	Chengdong Yang, Jianlong Qiu, Wenyin Zhang	Knowledge granulation based roughness measure for neighborhood rough sets	In this work, to overcome the limitations of the classical roughness, a new uncertainty measure based on knowledge granulation for neighbourhood rough sets and its properties is proposed. The roughness measures gives information that is included by uncertainty link to the granularity of the indiscernibility relation in addition to the upper approximation

			and lower approximation.
2017	Yao Liu , Junjie Yang, Yuehua Chen , Kezhu Tan , Liguo Wang, Xiaozhen Yan	Stability analysis of hyperspectral band selection algorithms based on neighborhood rough set theory for classification.	In this work, they showed a full comparison of the stability of six different band selection 46 algorithms that use different NRS theory evaluation criteria. They looked at how stability 47 changes across band selection algorithms or within each algorithm when the experiment is set up in different ways. For a more in-depth understanding of the stability problem, several things that can affect stability are talked about. They showed that the level of perturbation, the amount of overlap between perturbation datasets, the size of the subset, and the size of the neighbourhood all have an effect on stability.
2019	Wenbo Yu, Miao Zhang, Yi Shen	Learning a local manifold representation based on improved neighbourhood rough set and LLE for hyperspectral dimensionality reduction	In this paper, an improved neighbourhood rough set (INRS) and local linear embedding (LLE)-based method for reducing the number of dimensions in hyperspectral data was proposed by them. The goal of the proposed method i.e, INRSLLE, was to learn the local manifold representation while taking into account the fact that hyperspectral data has a lot of dimensions. Using the spectral-spatial information of hyperspectral data, Euclidean distance and spectral distance are used to choose neighbour candidates. From the original data, a parameter undirected graph was built to improve the ability to filter out noise. To fully prove that the proposed method is better, four different classifiers were used to sort dimension-reduced data from the proposed method and comparison methods like NMF and LP-KSVD. Experiments using different ways to compare show that the proposed INRSLLE performs better in terms of how well it classifies.

Discussion and Conclusion:

To deal with the ambiguity and uncertainty of decision systems, RST is a well-known mathematical tool. In numerous application domains, it has been successfully used for feature selection. The inability of RST to directly handle continuous values is one of its main flaws. Due to the continuous features of hyperspectral data, the outcomes of traditional RST-based band selection techniques depend on the discretization technique used to discretize the continuous band values. The NRS algorithm is a rough set variant that can analyze continuous data without discretization.

In this project, after surveying the papers, we have observed that the results of the existing work shows that the pre-determined neighbourhood granule threshold value affects how sensitive NRS-based band selection techniques are. The neighbourhood granule threshold size in the research is explicitly determined.

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