IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

A SURVEY ON BIG DATA REMOTE SENSING IMAGE CLASSIFICATION USING DEEP LEARNING TECHNIQUES

Ms.MH.Vahitha Rahman[1] Dr.M.Vanitha[2]
[1]Ph.D Research Scholar, Department Of Computer Applications, Alagappa University, Karaikudi, India,
[2]Assistant Professor, Department Of Computer Applications, Alagappa University, Karaikudi, India,

ABSTRACT

Big data analysis undertakes a significant role in Earth statement by means of remote sensing images, meanwhile the explosion of data images as of multiple sensors is used in copious fields. The old-style data analysis techniques have different limitations on storing and processing enormous volumes of data. In addition, gigantic remote sensing data analytics demand sophisticated algorithms constructed on specific techniques towards store to process the data in real-time or in near real-time with high accuracy, efficiency, and high speed. Remote sensing image classification plays an important role in the earth analysis technology using Remote Sensing Data Though, due to the individualities of Remote Sensing data such as high dimensionality as well as moderately lesser amounts of labeled samples available, accomplishment Remote Sensing image classification faces great scientific and practical challenges. In modern years, as innovative Deep Learning techniques emerge, approaches to Remote Sensing image classification with Deep Learning have succeeded significant innovations, offering novel opportunities for the research and development of Remote Sensing image classification. Deep learning is currently an extremely active research area in machine learning and pattern recognition as the data keeps getting larger, deep learning is coming to play a key role in providing big data predictive analytics solutions. In this survey paper, a brief overview of Big Data, Deep learning, Image processing with classification and Indexing of image storage nodes are provided Some important open issues and further research directions will also be presented for the next step of remote sensing image classification in big data analytics.

Keywords – Big Data; Deep Learning; Remote Sensing; Image Classification; Indexing of image

1.INTRODUCTION

Big data is a tenure that refer to enormous volumes of high velocity, complex and variable data that have need of advanced techniques and technologies in the direction of facilitate the capture, storage, distribution, management, and analysis of the statistics. A big data volumes are per diem generated at unprecedented rate from heterogeneous sources

(e.g., health, government, social networks, marketing, financial). This is due to voluminous techno logical trends, including the Internet of Things, the proliferation of the Cloud Computing as well as the spread of smart devices. Roundabout of the technical hitches related to big data include capture, storage, search, sharing, analytics, and visualizing. At present, enterprises be there exploring large volumes of highly detailed data so as to discover facts they didn't know before. Three main features distinguish big data: volume, variety, and velocity. The volume of the data is its size, and how enormous it is. Velocity discusses to the rate with which data is changing, otherwise how often it is created. Finally, variety includes the different formats and types of data, as well as the dissimilar kinds of uses and ways of analyzing the data.

2. DEEP LEARNING

The presence of deep learning in modern years emerging as a powerful tool and has become a prominent machine learning tool in computer vision and analysis of image, satellite image analysis approaches have enabled significant advances. It has opened up novel potentials for the research and development of new procedures and approaches aimed at satellite image analysis. Therefore, the Deep Learning has become the essential solution for deciphering remote sensing problems like classification and clustering. In the era of massive data, deep learning shows very interesting perspectives. It is experiencing exceptional success in many applications. Deep Learning uses machine learning procedures involving supervised and/or unsupervised strategies to learn hierarchical representations in deep architectures. Deep Learning uses deep structural design in order to deal by means of complex relationships between the input data and the class label. Deep Learning and ensemble-based algorithms were very prevalent and efficient for multisource and multi temporal remote sensing image classification. They perform better than SVM (Support Vector Machine) as the Deep Learning can deal not only with optical images but also with radar images. Deep Learning showed a better appearance in extracting features from hyperspectral and multispectral images such as extracting types of labels, pixel-based classification, semantic segmentation, and recognition of objects and classes.

3. IMAGE CLASSIFICATION

Image classification is the procedure of classifying besides labeling clutches of pixels or vectors within an image established on specific rules. The categorization law can be planned using one or more spectral or textural appearances. Two common approaches of classification are 'supervised' and 'unsupervised'. Classification maps are probably the main product of remote sensing image processing. Important applications are urban monitoring, catastrophe valuation, change or target detection. Broadly speaking, classification methods can be divided in three families. Unsupervised methods aim at clustering the image pixels into a pre-defined number of groups by measuring their similarity. One of the main applications for such methods is change detection, where the method should be able to recognize changes in real time. Supervised methods use labeled information to train a model capable to recognize pre-defined classes.

At present, this field is probably the most active in remote sensing image processing. The most successful methods are neural networks and support vector machines. The latter have been applied in a wide range of domains, including object recognition, multi-temporal classification and urban monitoring. Target and anomaly detection is also very active and kernel methods have been lately payed attention. Finally, semi-supervised methods exploit the information

about the unlabeled samples to improve the performance of supervised methods. In remote sensing, the data manifold has been modeled with either graphs or cluster kernels algorithms. An indexed image consists of an image matrix and a color map. A color map is matrix of data type double through values in the range [0, 1]. Each row of the color map specifies the red, green, and blue components of a single color. The pixel values in the image matrix are direct indices into the color map. Image processing, application be able to resize and compress all the user-uploaded images, which can significantly improve your application performance and save your server disk space.

4.LITERATURE SURVEY

Hanen Balti; Nedra Mellouli; Imen Chebbi; Imed Riadh Farah and Myriam Lamolle.[13], This methodology is progress in satellite technology has resulted in explosive growth in volume and quality of high resolution remote sensing images. To solve the issues of retrieving high-resolution remote sensing data in both efficiency and precision, this paper proposes a distributed system architecture aimed at object detection in satellite images using a fully connected neural network. On the one hand, to address the dispute of higher computational complexity and storage ability, the Hadoop framework is used towards handle satellite image data using parallel architecture. On the other hand, deep semantic features are extracted by means of Convolutional Neural Network (CNN), in order to classify objects and accurately locate them.

Wenmei Li;Haiyan Liu;Yu Wang;Zhuangzhuang Li;Yan Jia;Guan Gui. [28],2019. This methodology a deep learning-based classification method for remote sensing images, particularly for High Spatial Resolution Remote Sensing (HSRRS) images through numerous changes and multi-scene classes. Specifically, to help develop the corresponding classification approaches in urban built-up areas, we consider four Deep Neural Networks (DNNs): Convolutional Neural Network (CNN), capsule networks (CapsNet), Same Model with A Different Training Rounding based on CNN (SMDTR-CNN) and 4) Same Model Through Different Training Rounding established on CapsNet (SMDTR-CapsNet). The enactments of the proposed methods are evaluated in terms of overall accuracy, kappa coefficient, precision, and confusion matrix.

Danfeng Hong; Lianru Gao; Naoto Yokoya; Jing Yao;[9] ,2021 This methodology a baseline clarification to the aforementioned difficulty by means of developing a general Multimodal Deep Learning (MDL) framework. In particular, examine a special case of Multi-Modality Learning (MML)—Cross-Modality Learning (CML) that exists far and wide in Remote Sensing image classification applications. By concentrating on “what,” “where,” and “how” to fuse, it shows different fusion strategies as well as in what way to train deep networks and build the network architecture. Exactly, five fusion architectures are introduced and developed, further being unified in our MDL framework. Further significantly, our framework is not only inadequate to pixel-wise classification tasks but also applicable to spatial information modeling with convolutional neural networks (CNNs).

Fan Hu;Gui-Song Xia;Wen Yang;Liangpei Zhang [11], 2020. This methodology two methods to generate semantic features, called Multi-Scale Deep Semantic Representation (MSDS) and Multi-Level Deep Semantic representation (MLDS), by means of take out CNN features as of different layers: MSDS, the final semantic features are learned by the PLSA with multi-scale features extracted from the convolutional layer of a pre-trained CNN; MLDS is extract

CNN features for densely sampled image patches next to different size level from the fully-connected layer of a pre-trained CNN, and concatenate the sematic features learned by the PLSA at each level.

Mengzhao Yang, Haibin Mei, Yuhao Yang and Dongmei Huang[19]2017" selection of rational number of image layer via the maximum division layer algorithm, the Spark oriented distributed construction method and RDDs (Resilient Distributed Datasets) on Spark system to represent data structures for metadata and ranks, and there is no need to materialize these data structures across multiple iterations. construction method and RDDs caching technology, the efficient storage structure of Remote Sensing image data, which can achieve high-performance processing of massive Remote Sensing image on Spark system.

Xue-Wen Chen And Xiaotong Lin [30]. In this policy, Deep learning is currently an extremely dynamic research area in machine learning and pattern recognition society. It has gained huge successes in a broad area of applications such as speech recognition, computer vision, and natural language processing. By means of the sheer size of data available today, big data conveys big opportunities and transformative potential for several sectors on the other hand, it also presents unprecedented challenges to harnessing data and information. As per the data keeps receiving bigger, deep learning is coming to play a key role in provided that big data predictive analytics solutions. a brief overview of deep learning, and the challenges to big data.

Lam Pham, Khoa Tran, Dat Ngo , Jasmin Lampert , Alexander Schindler ,[17] In this analyses classifying remote sensing images into groups of semantic categories based on their contents, has taken the important role in an eclectic range of applications such as urban planning, natural hazards detection, environment monitoring, vegetation mapping, or geospatial object detection. the power of deep learning technology, estimate a variety of deep neural network architectures, designate main factors affecting the performance of a RSISC system. propose a deep learning founded framework for RSISC, which makes use of the transfer learning technique and multi head attention scheme. It assessed on the benchmark NWPU-RESISC45 dataset and completes the best classification accuracy of 94.7% which shows competitive to the state-of-the-art systems and potential for real-life applications.

Akey Sungheetha, Rajesh Sharma R [2] (2021). A technique that uses bilinear convolution neural networks towards produce a less weighted set of models those results in better visual recognition in remote sensing images by means of fine-grained techniques. To extract scene feature statistics in two times from remote sensing images for improved recognition. In layman's terms, these features are defined as raw, and only have a single defined frame, so they will allow basic recognition from remote sensing images. a dual feature extraction hybrid deep learning method to categorize remotely sensed image scenes based on feature abstraction techniques. It is applied to feature values in order to convert them to feature vectors that have pure black and white values after many product operations. The next stage is pooling and normalization, the CNN feature extraction process has changed. a novel hybrid framework method that has a better level of accuracy and recognition rate than any prior model.

Cheng, X.; Lei, [6] H. a new classification methodology using an mms CNN–HMM collective model with stacking ensemble mechanism a modified multi-scale convolution neural network (mms CNN) is proposed towards extract multi-scale structural features, which has a lightweight structure besides can avoid high computational complexity the

preliminary predicted values generated by the HMM group are used in an extreme gradient boosting (XGBoost) model to generate the final prediction. the trained XGBoost model conducts the scene grouping prediction. In this paper, the six most widely used remote sensing scene datasets, UCM, RSSCN, SIRI-WHU, WHU-RS, AID, and NWPU, are selected to carry out all kinds of trials.

Adriana Romero, Carlo Gatta and Gustau Camps-Valls,[1]2015 the use of greedy layer-wise unsupervised pre-training coupled with a highly efficient algorithm for unsupervised learning of sparse features. classification of aerial scenes, as well as land-use classification in very high resolution (VHR), or land-cover classification from multi- and hyper-spectral images. The proposed algorithm clearly outperforms standard Principal Component Analysis (PCA) and its kernel counterpart (kPCA), as well as current state-of-the-art algorithms of aerial classification, while being extremely computationally efficient at learning representations of data. Results show that single layer convolutional networks can extract powerful discriminative features only when the receptive field accounts for neighboring pixels, and are preferred when the classification requires high resolution and detailed results. However, deep architectures significantly outperform single layers' variants, capturing increasing levels of abstraction and complexity throughout the feature hierarchy

Bindhu J S , Pramod K V [4]2022 pre-processes the input image with an adaptive bilateral filtering approach. Then, the pre-processed input image is given as an input to the proposed Optimized Deep Convolutional Neural Network (ODCNN) for improved feature learning and classification. Here, the ODCNN structure is utilized to classify different scenes in the satellite images accurately. the modified beetle swarm optimization (MBSO) algorithm is utilized for weights optimization in the ODCNN classifier. This process improves the learning of the ODCNN classifier by accurately detecting the scene in remote sensing images. This work presents a deep learning framework for accurately classifying scene types through improved learning.

Biserka Petrovska , Eftim Zdravevski , Petre Lameski , Roberto Corizzo , Ivan Štajduhar , and Jonatan Lerga [5]2020 remote sensing image classification can be further explored with extracting features on or after lower layers of pre-trained deep CNN, the Support Vector Machine for the classification of the concatenated features. The competitiveness of the surveyed technique was evaluated on two real-world datasets: UC Merced and WHU-RS. The achieved classification accuracies determine that the considered scheme has competitive results compared to other cutting-edge techniques.

Fangjian Liu , Lei Dong, Xueli Chang and Xinyi Guo[11] 2022 Landsat 8 images are used as experimental data, and Wuhan, Chengde and Tongchuan are selected as research areas. The best neighborhood window size of the image patch and band combination method are selected based on two sets of comparison experiments. Then, an object-oriented convolutional neural network (OCNN) is used as a classifier. The experimental results show that the classification accuracy of the OCNN classifier is 6% higher than that of an SVM classifier and 5% higher than that of a convolutional neural network classifier. The graph of the classification results of the OCNN is more continuous than the plots obtained with the other two classifiers, and there are few fragmentations observed for most of the category.

The OCNN successfully solves the salt and pepper problem and improves the classification accuracy to some extent, which verifies the effectiveness of the proposed object-oriented model

Mingyuan Xin and Yong Wang[20] 2019M3 CE-CEc on two deep learning standard databases, MNIST and CIFAR-10. The experimental results show that M3 CE can enhance the cross-entropy, and it is an effective supplement to the cross-entropy criterion. M3 CE-CEc has obtained good results in both databases. The training network can extract features by parallel computation, and its parameters and computational complexity are obviously smaller than those of the traditional neural network. Its layout is closer to the actual biological neural network. Weight sharing can greatly reduce the complexity of the network structure. Especially, the multi-dimensional input vector image WDIN can effectively avoid the complexity of data reconstruction in the process of feature extraction and image classification.

Peng Dou , Huanfeng Shen , Zhiwei Li , Xiaobin Guan [25]2021 TSI(time series image) and combination of deep learning and multiple classifiers system (MCS). Firstly, we used a normalized difference index (NDI) to establish an NDI based TSI and then designed a framework consisting of a deep learning-based feature extractor and multiple classifiers system (MCS) based classification model to classify the TSI. With the new approach, experiments were conducted on Landsat images located in two counties, Sutter and Kings in California, United States. The experimental results indicate that proposed method achieves great progress on accuracy improvement and LULC mapping, outperforming classifications using comparative deep learning and non-deep learning methods.

Xiangchun Liu1, Jing Yu ,Wei Song, Xinping Zhang , Lizhi Zhao and Antai Wang [29]2020 The experimental tests are carried out through the standard test dataset SAT-4 and SAT-6. results show that reducing the number and dimension of image extraction features, reducing the difficulty of classification learning, reducing the hidden layer of the learning network. The number of layers avoids the parameter optimization adjustment and reduces the complexity of learning the network structure.

Zhao Shun, Danyang Li, Hongbo Jiang, Jiao Li, Ran Peng, Bin Lin, QinLi Liu, Xinyao Gong, Xingze Zheng and Tao Liu[32] 2022 An asymmetric convolution-CBAM (AC-CBAM) module based on the convolutional block attention module is proposed. This optimization module of the integrated attention and sliding window prediction method is adopted to effectively improve the segmentation accuracy.

5.RESULTS

The several remote sensing image classification of the survey characterized in the table1. Here, various remote sensing image classification techniques compared and analyzed the performances of such typical methods

TABLE.1

VARIOUS REMOTE SENSING FOR IMAGE CLASSIFICATION

AUTHORS	YEAR AND REFERENCE	TECHNIQUE	PERFORMANCE
Mengzhao Yang, Haibin Mei, Yuhao Yang, Dongmei Huang.	2017[19]	Spark Oriented Distributed Construction Method And Rdds (Resilient Distributed Datasets)	Efficient Storage Structure Of Remote Sensing Image Data
Hanen Balti, Nedra Mellouli, Imen Chebbi, Imed Riadh Farah, MyriamLamolle.	2019[13]	Convolutional Neural Network	Classify Objects and Accurately
Akey Sungheetha, Rajesh Sharma R.	2021[2]	Novel Hybrid Framework Method	Better Level Of Accuracy And Recognition Rate
Peng Dou , Huanfeng Shen , Zhiwei Li , Xiaobin Guan	2021[25]	Time Series Image, Multiple Classifiers System and Normalized Difference Index	Accuracy Improvement and Mapping
Bindhu J S, Pramod K V.	2022[4]	Optimized Deep Convolutional Neural Network	Classify Different Scenes In The Satellite Images Accurately.
Zhao Shun, Danyang Li, Hongbo Jiang, Jiao Li, Ran Peng, Bin Lin, QinLi Liu, Xinyao Gong, Xingze Zheng , Tao Liu	2022[32]	Asymmetric Convolution Block Attention Module	Effectively Improve Segmentation Accuracy.
Fangjian Liu , Lei Dong, Xueli Chang, Xinyi Guo	2022[11]	Object-Oriented Convolutional Neural Network	Improves Classification Accuracy

6.CONCLUSION

The appearance of deep learning has provided an opportunity for mining and analyzing big remote sensing data. Deep learning model play an important role in Remote Sensing image classification research. This paper presents a survey is to fleetingly introduced a number of typical Deep Learning models that might be used to accomplish Remote Sensing image classification Following the introduction, from main perspectives, pixel-wise image classification and Multi spectral images, systematically reviewed the state-of-the-art Deep Learning approaches for Remote Sensing image

classification. SVM techniques that have been proposed in recent years. These techniques may likewise lead to virtuous performance and therefore should be worth paying attention to. It compared and analyzed the performances of such typical methods. In future, survey represented the performance of Deep Learning based Remote Sensing classification techniques has shown their effectiveness and solving some limitation issues and improve manage multi-spectral images new classification techniques and extracting high volume of the data on big data analytics.

References

1.**Adriana Romero, Carlo Gatta and Gustau Camps-Valls, S** 2015Unsupervised Deep Feature Extraction for Remote Sensing Image Classification

2.**Akey Sungheetha, Rajesh Sharma R,** Classification of Remote Sensing Image Scenes Using Double Feature Extraction Hybrid Deep Learning Approach, Journal of Information Technology and Digital World (2021).

3.**Beigeng Zhao A** Systematic Survey Of Remote Sensing Image Captioning Digital Object Identifier 10.1109/Access.2021.3128140.

4.**Bindhu J S , Pramod K V** 2022 A Novel Approach for Satellite Image Classification using Optimized Deep Convolutional Neural Network

5.**Biserka Petrovska , Eftim Zdravevski , Petre Lameski , Roberto Corizzo , Ivan Štajduhar , and Jonatan Lerga** 2020 Deep Learning for Feature Extraction in Remote Sensing: A Case-Study of Aerial Scene Classification

6.**Cheng, X.; Lei, H.** Remote Sensing Scene Image Classification Based on mms CNN–HMM with Stacking Ensemble Model. Remote Sens. 2022, 14, 4423.

7.**Chun-Wei Tsai , Chin-Feng Lai , Han-Chieh Chao, And Athanasios V. Vasilakos Tsai Et Al**. Big Data Analytics: A Survey Journal Of Big Data (2015) 2:21.

8.**Danfeng Hong, Lianru Gao, Naoto Yokoya, Jing Yao, Jocelyn Chanussot, Qian Du, And Bing Zhang**, 2020 More Diverse Means Better: Multimodal Deep Learning Meets Remote Sensing Imagery Classification.

9.**Devis Tuia Gustavo Camps-Valls** Recent Advances in Remote Sensing Image Processing 21 May 2014.

10. **Fan Hu;Gui-Song Xia;Wen Yang;Liangpei Zhang** "Mining Deep Semantic Representations for Scene Classification of High-Resolution Remote Sensing Imagery", (Volume: 6, Issue: 3, 01 September 2020).

11. **Fangjian Liu , Lei Dong1 , Xueli Chang and Xinyi Guo** 2022Remote sensing image classification based on object-oriented convolutional neural network

12. **Gong Cheng , Xingxing Xie, Junwei Han , Lei Guo, And Gui-Song Xia** , Remote Sensing Image Scene Classification Meets Deep Learning: Challenges, Methods, Benchmarks, And Opportunities Vol. 13, 2020

13. **Hanen Balti; Nedra Mellouli; Imen Chebbi; Imed Riadh Farah and Myriam Lamolle**. "Deep Semantic Feature Detection from Multispectral Satellite Images Jan. 2019.

14. **Imen Chebbi , Nedra Mellouli , Imed Riadh Farah And Myriam Lamolle.** Big Remote Sensing Image Classification Based On Deep Learning Extraction Features and Distributed Spark Frameworks 2021, 5, 21.

15. **Jia Song , Shaohua Gaob , Yunqiang Zhua, And Chenyan** Mab Big Earth Data 2019, A Survey Of Remote Sensing Image Classification Based On Cnns Vol. 3, No. 3, 232–254.

16. **Junfei Qiu, Qihui Wu, Guoru Ding , Yuhua Xu And Shuo Feng Qiu Et A**. A Survey Of Machine Learning For Big Data Processing Eurasip Journal On Advances In Signal Processing (2016) 2016:67.

17. **Lam Pham , Khoa Tran , Dat Ngo , Jasmin Lampert , Alexander Schindler**, Remote Sensing Image Classification Using Transfer Learning And Attention Based Deep Neural Network 20 Jun 2022.

18. **Lei Maa,B,E,G, Yu Liuc , Xueliang Zhanga , Yuanxin Yed , Gaofei Yind , Brian Alan Johnsonf** Deep Learning In Remote Sensing Applications: A Meta-Analysis And Review Isprs Journal Of Photogrammetry And Remote Sensing 2019.

19. **Mengzhao Yang , Haibin Mei , Yuhao Yang And Dongmei Huang,** Efficient Storage Method For Massive Remote Sensing Image Via Spark-Based Pyramid Model Icic International C 2017 Issn 1349-4198.

20. **Mingyuan Xin and Yong Wang** 2019 Research on image classification model based on deep convolution neural network

21. **Mohd Azlan Abu , Nurul Hazirah Indra , Abdul Halim Abd Rahman , Nor Amalia Sapiee And Izanoordina Ahmad** A Study On Image Classification Based On Deep Learning And Tensorflow Issn 0974-3154, Volume 12, Number 4 (2019).

22. **Munirah Alkhelaiwi , Wadii Boulila , Jawad Ahmad , Anis Koubaa And Maha Driss** An Efficient Approach Based On Privacy-Preserving Deep Learning For Satellite Image Classification Remote Sens. 2021, 13, 2221.

23. **Nada Elgendy and Ahmed Elragal** Big Data Analytics: A Literature Review Paper Conference Paper in Lecture Notes in Computer Science · August 2014.

24. **Peng Liu,** A Survey of Remote-Sensing Big Data 17 June 2015.

25. **Peng Dou , Huanfeng Shen , Zhiwei Li , Xiaobin** Guan 2021 Time series remote sensing image classification framework using combination of deep learning and multiple classifiers system

26. **Ripon Patgiri, And Arif Ahmed** Big Data: The V's of The Game Changer Paradigm 2016.

27. **Sen Jia , Shuguo Jiang , Zhijie Lin , Nanying Li , Meng Xu , Shiqi Yu** Survey: Deep Learning For Hyperspectral Image Classification With Few Labeled Samples ,2021.

28. **Wenmei Li;Haiyan Liu;Yu Wang;Zhuang Li;Yan Jia;Guan Gui.** "Deep Learning-Based Classification Methods for Remote Sensing Images in Urban Built-Up Areas", IEEE Access (Volume: 7) Jan. 2019

29. **Xiangchun Liu1, Jing Yu ,Wei Song, Xinping Zhang , Lizhi Zhao and Antai Wang** 2020 Remote Sensing Image Classification Algorithm Based on Texture Feature and Extreme Learning Machine

30. **Xue-Wen Chen and Xiaotong Lin** "Big Data Deep Learning: Challenges and Perspectives" date of current version May 28, 2014.Digital Object Identifier 10.1109/ACCESS.2014.2325029.

31. **Ying Li | Haokui Zhang | Xizhe Xue | Yenan Jiang | Qiang Shen** Deep Learning for Remote Sensing Image Classification: A Survey 2018.

32. **Zhao Shun, Danyang Li, Hongbo Jiang, Jiao Li, Ran Peng, Bin Lin, QinLi Liu, Xinyao Gong, Xingze Zheng and Tao Liu** 2022Research on remote sensing image extraction based on deep learning.