26140: Deep clustering networks for hyperspectral remote sensing images

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Aantal studenten:	1	Richting:	Master of Science in Computer Science Engineering [EMCOSC] Master of Science in de industriële wetenschappen: informatica [EM7INF] Master of Science in de informatica [CMINFO] Master of Science in Electrical Engineering - afstudeerrichting Communication and Information Technology [EMELECCI] Master of Science in Industrial Engineering and Operations Research [EMIEOR]
Aantal masterproeven:	1	Academiejaar:	2021-2022

Onderwerp ingediend door: dr. Shaoguang Huang

Motivering per studierichting

Master of Science in Computer Science Engineering :	The involved machine learning and image processing techniques in this thesis proposal is very relevant.
Master of Science in de industriële wetenschappen: informatica:	The involved machine learning and image processing techniques in this thesis proposal is very relevant.
Master of Science in de informatica:	The involved machine learning and image processing techniques in this thesis proposal is very relevant.
Master of Science in Electrical Engineering - afstudeerrichting Communication and Information Technology:	The involved machine learning and image processing techniques in this thesis proposal is very relevant.
Master of Science in Industrial Engineering and Operations Research:	The involved machine learning and image processing techniques in this thesis proposal is very relevant.

Eindscorepercentages

Indien het onderwerp wordt toegekend aan een student industriële wetenschappen:

persoonlijke kenmerken	10%
praktische realisatie	40%
masterproeftekst	30%
openbare verdediging	20%

Indien het onderwerp wordt toegekend aan een student ingenieurswetenschappen:

praktische en persoonlijke aspecten	30%
wetenschappelijke aspecten	50%
openbare verdediging	20%

Trefwoorden:

deep learning, imge processing, unsupervised learning, clustering

Probleemstelling:

Hyperspectral image (HSI), which captures rich spectral information of objects within more than hundreds of bands as shown in Fig. 1, has been widely used in many applications such as defense and security, precision agriculture and climate change monitoring. Automatic analysis of hyperspectral image relies greatly on classification, as a means of identifying areas in the imaged scenes to some specific classes. Since data labeling in remote sensing applications is typically labor intensive and time-consuming, labeled data required for training the classifiers are often scarce, posing serious limitations for supervised classification. Clustering, as an unsupervised classification approach, which requires no labeled data, is thus crucial in this domain.

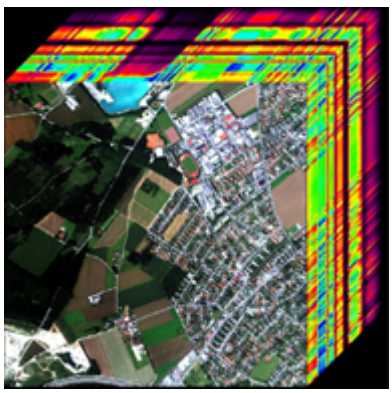

Fig. 1. Hyperspectral image contains more than hundreds of spectral bands.

In the task of HSI clustering, which aims to group pixels into different clusters (often correspond to land covers), traditional clustering methods including k-means, fuzzy c-means, density-based methods and spectral clustering often show limited performance in terms of clustering accuracy due to noise and large spectral variability within-cluster. While recent subspace clustering methods [1] by sparse coding achieved excellent clustering performance, their ability in extracting discriminative features is limited due to the adopted

linear and shallow representation models. The latest deep clustering methods [2] [3] (see an example in Fig. 2) integrate unsupervised neural networks such as autoencoder with traditional clustering models like k-means and subspace clustering, which have achieved the state-of-the-art performance. However, they are mostly designed for the computer vision tasks such as clustering of facial images or online documents or hand written text (image level clustering). Analogous study in HSI clustering is very limited. Applying such algorithms directly to HSI clustering is not feasible and often leads to unsatisfactory results due to the completely different types of data and tasks. Thus, effective solutions are needed for deep clustering models in this domain.

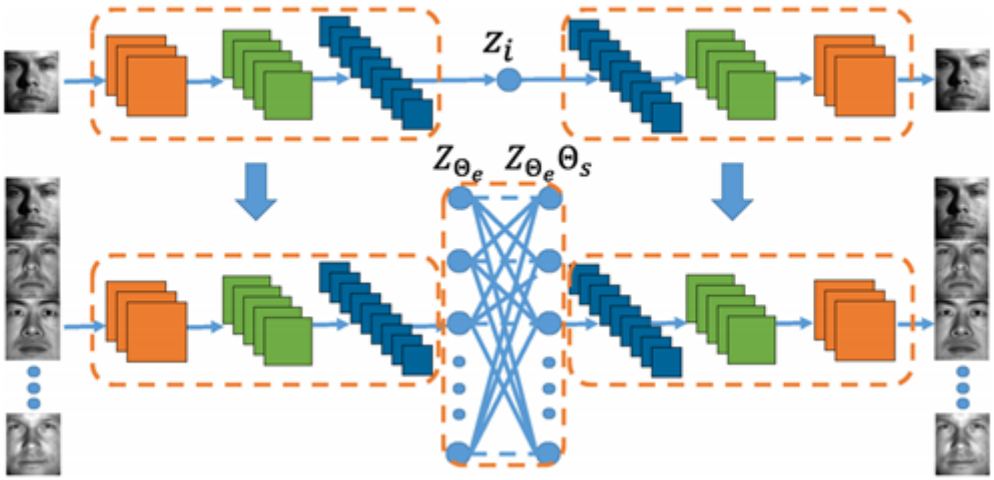

Fig. 2. Deep subspace clustering networks [2], consisting of three convolutional encoder layers, one self-representation layer, and three deconvolutional decoder layers.

References:

[1] S. Huang, H. Zhang and A. Pizurica, Semisupervised sparse subspace clustering method with a joint sparsity constraint for hyperspectral remote sensing images, IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens., 12(3) (2019) 989–999.

[2] P. Ji, et al., Deep subspace clustering networks. arXiv preprint: 1709.02508, 2017.

[3] X. Peng, et al., Deep subspace clustering. IEEE Trans. Neural Netw. Learn. Syst. 31(12) (2020) 5509-5521.

Doelstelling:

The goal of this Master thesis is to improve recent deep clustering models for HSI clustering. Following issues will be addressed:

1. Build an unsupervised neural network architecture, which allows simultaneous feature extraction and learning of cluster structure.

2. Introduce a spatial regularization to improve clustering results.

3. Develop an efficient algorithm to solve the resulting model and conduct experiments to validate the effectiveness of the developed model.

The students will start with the released codes of existing deep clustering models that are designed for computer vision. Real experimental data sets will be provided.

Samenwerking met een bedrijf:

Y

Naam van het bedrijf of onderzoeksproject in samenwerking met industrie:
Robovision

Rol van de samenwerking: use case, Results validation

Embargodatum voor publiek beschikbaar maken van masterproef:

00/00/0000

Locatie:

Acties:

Onderwerp kopieren (naar AJ 2021-2022) | Onderwerp wijzigen | Onderwerp verwijderen