MATH 6380P Final Project. Nexperia Image Classification

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1. Introduction

In the final project, we use scattering net to do feature extraction and would later compare results between extracted features and raw data. We first visualized the features as well as the raw data to get a brief idea of their difference. Lastly, we use traditional methods to do classification on the features as well as the raw data to compare their performances. The dataset in this project would be Nexperia image dataset. Set detect defect images as our target, our goal would be getting higher power as much as possible which controls false discoveries.

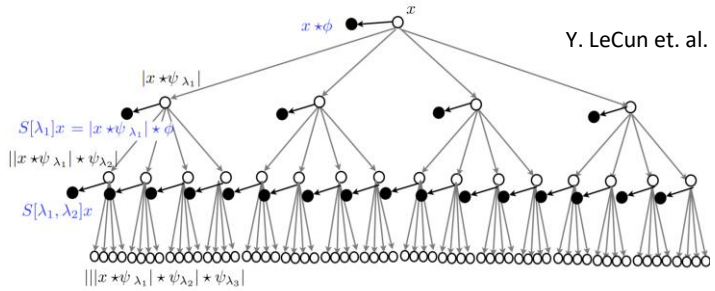
2. Dataset

Nexperia image dataset is made up with images of semiconductor devices with two main classes, good and defect. The dataset contains 34457 training samples (27420 good and 7039 defect) and 3830 test samples with similar good-defect ratio. Each sample in the dataset is of shape (3, 267, 275).

3. Feature Extraction

Methodology: Scattering net

- A feature extractor similar to convolutional network, while the filter is fixed.



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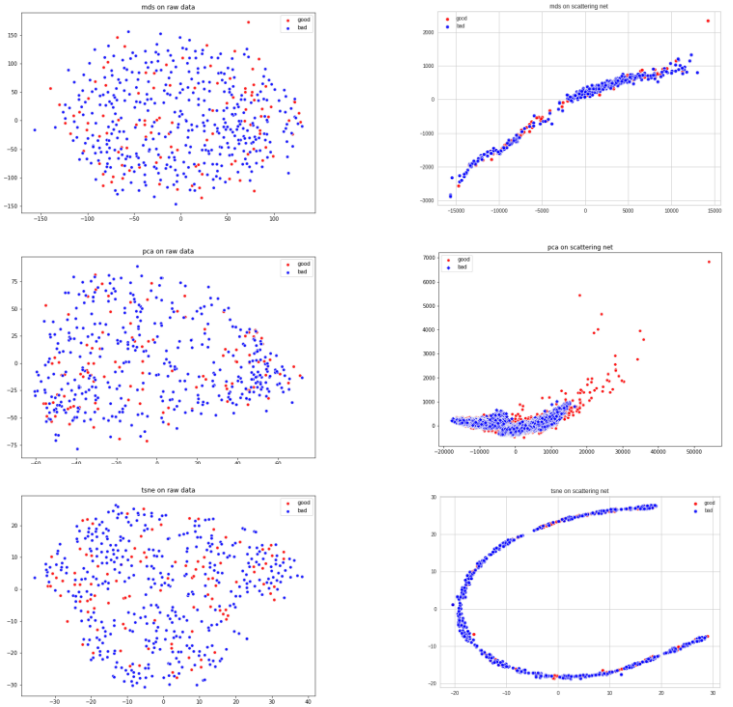
4. Visualization

We would show the visualization of both raw data (left row) and features extracted by scattering net (right row). The visualization method that we use in this section is MDS,PCA and t-SNE.



As we can see from the plots, the features extracted by scattering net are much more organized than the raw data. However, instead of the neural collapse phenomenon, we observe that the features are probably converge to a ring in a higher dimensional space.

5. Classification

For the classification step, we use random forest, logistic regression, support vector machine and linear discriminant analysis on both raw data and extracted features to observe the difference in their performance.

Train Error	RF	LR	SVM	LDA
RAW	0.000	0.001	0.135	0.050
Scattering net	0.000	0.210	0.204	0.190
Test Error	**RF**	**LR**	**SVM**	**LDA**
RAW	0.591	0.498	0.690	0.650
Scattering net	0.190	0.392	0.600	0.441

As we can see from the tables, although directly doing classification has lower training error rate, it would have higher test error rate.

6. Conclusion

In this final project, we show that although features extracted by scattering net may not satisfy the neural collapse assumption, the features would be more organized and would converge to some other simple structures. The classification result shows the extracted features have better generalization property than the raw data, which would in some sense shows that the features are invariant.

8. Contribution

Analysis + Poster

- CAO Yang

Feature Extraction + Visualization + Classification + Poster

- WU Jiamin