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学位（博士）論文要旨

(Doctoral thesis abstract)

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論 文 題 目 (Title)	Graph Convolutions using local structures in feature space for Graph Neural Networks

論文要旨 (2000 字程度)
(Abstract(400 words))
※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。
(in English or in Japanese)

Graph Convolutions (GCs) using local structures in feature space for Graph Neural Networks (GNNs) are studied in this dissertation.

How to process irregular data is one of the hot topics in signal processing. Most irregular data can be represented using graph data. Therefore, graph signal processing is also a key research topic in signal processing. Many graph signal processing methods have been proposed.

Using deep neural networks to process graph data has also received much attention. The key to GNNs is to design the GC methods, i.e., graph filters. Existing GCs occur over-smoothing. Over-smoothing makes node-wise features of each node to be the same. Therefore, over-smoothing may influence the performance of GNNs. Improving the expressive of GCs can avoid over-smoothing.

The goal of this dissertation is to propose new spatial GCs for GNNs. They have high-expressive by using local structures in feature space.

This dissertation is organized as follows. Chapter 1 introduces the motivation and the limitations of the existing GCs. The basic knowledge and related works are described in Chapter 2. The main contributions of this dissertation are described in Chapters 3-5, whose summaries are represented as follows.

In Chapter 3, We first proposed three structural features—feature angle, feature distance, and relational embedding—to describe the structural information of the surrounding neighboring nodes in the feature space. Then, we introduce these structural features into spatial GC to propose a new Structure-aware GC, i.e., SAGConv.

In Chapter 4, to further improve the expressive of GC. We propose a spatial GC

aggregating multi-hop features. In contrast to the iteration of one-hop feature aggregation, multi-hop features are aggregated simultaneously in the one-step GC in our method. We utilize this spatial GC and the structural features simultaneously to present our Structure-aware Multi-hop GC (SAMGC).

In Chapter 5, we first propose an attention function utilizing multi-type attention functions simultaneously. Therefore, it can get better attention weights. Then, we simultaneously use the proposed attention function and structural features to present our attention-based spatial GC—Multi-type Structure and Position-aware attention-based Graph Convolution (MTSPAGC).

Finally, this dissertation is concluded in Chapter 6.

（英訳）※和文要旨の場合(400 words)