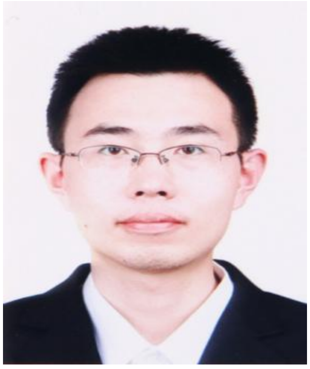
Title: WSSGCN: Wide Sub-stage Graph Convolutional Networks



Presenting Author Details:

Name: Chao Wang
Affiliation: China Academy of Railway Sciences Corporation Limited, Beijing, China

Co-Authors:

Zheng Tang, Affiliation: NVIDIA, Redmond, USA

Hailu Xu, Affiliation: California State University, the Department of Computer Engineering and Computer Science, Long Beach, USA

Abstract:
Graph Convolutional Networks (GCNs) have emerged as a potent tool for learning graph representations, finding applications in a plethora of real-world scenarios, including the field of healthcare, where they hold promise for tackling complex diseases such as Alzheimer's. Alzheimer's disease (AD) is characterized by intricate and multifaceted pathological networks involving neuronal connections and interactions that are not easily represented through traditional data structures. GCNs, with their capability to capture relationships between nodes and model interdependencies within graph-structured data, offer a promising approach for analyzing such complex networks.

However, a significant portion of deep learning research has predominantly concentrated on enhancing model performance by constructing deeper GCNs. Unfortunately, training deep GCNs faces two fundamental challenges: the inadequacy of conventional methodologies to handle heterogeneous networks, and the exponential surge in model complexity with increasing network depth, which complicates interpretability and reduces practical utility in clinical applications. This imposes constraints on deploying GCNs to analyze data effectively.

To surmount these limitations, we propose an innovative approach named the Wide Sub-stage Graph Convolutional Network (WSSGCN), tailored to address both the depth and width limitations of GCNs. Specifically, WSSGCN adopts a staged convolutional network framework that reflects a step-by-step learning process akin to human cognition, which is particularly valuable for tackling the nuanced progression and layered complexity of Alzheimer's pathology.

Our framework prioritizes three distinct forms of consistency—response-based, feature-based, and relationship-based—to ensure robust learning across multi-dimensional relationships. This structured approach involves three tailored convolutional networks that capture hierarchical insights at multiple scales. Additionally, WSSGCN introduces a novel method for expanding graph width, providing an efficient way to train GCNs without necessitating excessive depth, thereby facilitating better computational efficiency and stability. This wide sub-stage configuration empowers WSSGCN to model complex biological networks more accurately, with empirical validations on benchmarks highlighting its superior accuracy and faster training speeds compared to conventional GCNs. By enabling more efficient and scalable graph

representation learning, WSSGCN could serve as a foundational tool in the pursuit of early diagnosis and personalized treatment strategies for healthcare.

Biography:

Chao Wang received a B.E. degree in Process Equipment and Control Engineering from Jiangnan University in 2007, and an M.S. degree in Computer Application Technology from Northeast University in 2010. In the same year, he joined the China Academy of Railway Sciences and is currently an Assistant Researcher. Since assuming this position in 2012, he has already had multiple invention patents and peer-reviewed publications. His published papers cover interdisciplinary research topics in the fields of neural networks, machine learning, big data and railway signal. His research interests include computer vision, graph neural networks, big data, cloud computing and intelligent rail transit systems.

Chao Wang has led or participated in several key projects in China's rail transportation industry, achieving significant socioeconomic benefits. In 2021, his team won the second prize of the Science and Technology Progress of Beijing Rail Transit Society Award. The project he participated in received the first prize of the China Academy of Railway Sciences Award in 2020. An invention patent he participated in won the China Excellent Patent Award in 2017.