Qi Chen

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EDUCATION

School of Mathematical Sciences, Peking University **09 2017 – 07 2023**
Ph.D. - Applied Mathematics *Beijing, China*
Supervised by Prof. Zhouchen Lin and Prof. Jiansheng Yang

School of Mathematical Sciences, Peking University **09 2013 – 07 2017**
BSc - Information and Computational Sciences *Beijing, China*

RESEARCH INTERESTS

- Deep Equilibrium Models
- Graph Neural Networks
- Image Processing

PUBLICATIONS

Equilibrium Image Denoising with Implicit Differentiation **2023**

- **Qi Chen**, Yifei Wang, Zhengyang Geng, Yisen Wang, Jiansheng Yang, Zhouchen Lin
- **IEEE Transactions on Image Processing**
- **Keywords**: Deep Equilibrium Models, Image Denoising
- Learning-based image denoising approaches use unrolled architectures with stacked blocks, which may lead to performance degradation and costs a lot of efforts to tune the appropriate number of blocks. Our approach is the first to model iterative image denoising through an implicit scheme. The proposed model is parameter-efficient and has only one implicit layer, which is a fixed-point equation that casts the desired noise feature as its solution. Extensive experiments show that our model leads to better performances than state-of-the-art explicit denoisers with enhanced qualitative and quantitative results.

Optimization-Induced Graph Implicit Nonlinear Diffusion **2022**

- **Qi Chen**, Yifei Wang, Yisen Wang, Jiansheng Yang, Zhouchen Lin
- **International Conference on Machine Learning (ICML)**
- **Keywords**: Deep Equilibrium Models, Graph Neural Networks
- We alleviate the over-smoothing problem of Graph Neural Networks (GNNs) by developing an implicit graph model, which not only has access to infinite hops of neighbors, but also adaptively aggregates features with nonlinear diffusion. Notably, we prove that the learned representation can be formalized as the minimizer of an explicit convex optimization objective. With this property, we induce structural variants from an optimization perspective to embed prior properties to the learned representation. Extensive experiments show that our model improves state-of-the-art implicit GNNs by a large margin on both node-level and graph-level tasks.

Efficient and Scalable Implicit Graph Neural Networks with Virtual Equilibrium **2022**

- **Qi Chen**, Yifei Wang, Yisen Wang, Jianlong Chang, Qi Tian, Jiansheng Yang, Zhouchen Lin
- **IEEE International Conference on Big Data (Big Data)**
- **Keywords**: Deep Equilibrium Models, Graph Neural Networks
- Implicit graph neural networks, aka Graph EQuilibrium models (GEQs), face severe efficiency and scalability issues caused by their root-finding process. To address these problems, we propose the first mini-batch training strategy for GEQs, where the root-finding process is persistent and continues from historical equilibrium of in-batch nodes and their out-of-batch neighbors. Theoretically, we provide convergence analysis that these historical equilibrium approximates the exact one along the training process. Empirically, our approach scales GEQs to OGB benchmarks, and achieves superior performance to many highly engineered explicit GNNs.

ACADEMIC SERVICES

Reviewer of ICML (2022-23), NeurIPS (2022-23), AAAI (2023)

SELECTED HONORS AND AWARDS

Peking University, **Dean's Scholarship of SMS** (2017), **Ubiquant Scholarship** (2022)

TECHNICAL SKILLS

Programming: Python, Matlab
Frameworks: Pytorch (Experienced), TensorFlow (Familiar)