國立陽明交通大學電信工程研究所
系統組論文研討

On optimal solutions of classical and sliced Wasserstein GANs with non-Gaussian data

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Abstract

The generative adversarial network (GAN) aims to approximate an unknown distribution via a parameterized neural network (NN). While GANs have been widely applied in reinforcement and semi-supervised learning as well as computer vision tasks, selecting their parameters often needs an exhaustive search and only a few selection methods can be proved to be theoretically optimal. One of the most promising GAN variants is the Wasserstein GAN (WGAN). Prior work on optimal parameters for WGAN is limited to the linear-quadratic-Gaussian (LQG) setting, where the NN is linear and the data is Gaussian. In this paper, we focus on the characterization of optimal WGAN parameters beyond the LQG setting. We derive closed-form optimal parameters for one-dimensional WGANs when the NN has non-linear activation functions and the data is non-Gaussian. As an extension to high-dimensional WGANs, we adopt the sliced Wasserstein framework and show that the linear generator can be asymptotically optimal for sliced WGAN with non-Gaussian data. However, the original sliced WGAN only constrains the projected data distribution but not the whole one in its marginal, and thus we propose another new sliced WGAN and identify its asymptotic optimality. Empirical studies show that compared to the celebrated r-principal component analysis (r-PCA) solution, our generator for sliced WGAN can achieve the same performance with much lower complexity.

Biography

Shih-Chun Lin (Senior Member, IEEE) received the B.S. and Ph.D. degrees in electrical engineering from National Taiwan University, Taipei, Taiwan, in 2000 and 2007, respectively. In August 2021, he joined National Taiwan University, where he is currently a Professor. His research interests include information theory, communications, and cyber–physical security. Prof. Lin received the Best Paper Award for Young Authors from the IEEE IT/COM Society Taipei/Tainan Chapter in 2015 and twice the Project for Excellent Junior Research Investigators from the Ministry of Science and Technology, Taiwan, in 2015 and 2018. In 2024, he won Outstanding Research Achievements for Industry-University Collaborations from MediaTek Advanced Research Center. He served as the TPC Co-Chair for the IEEE ICC Workshop on B5G-URLLC 2019 and the Publication Chair for IEEE ISIT 2023 and IEEE Globecom 2020.