IEEE Transactions on Industrial Informatics

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for Special Section on

How Do Deep Generative Models Solve Data Issues in Industrial IoT

Theme: The huge amount of data collected from Industrial Internet of Things (IIoT) have already become the primary productive forces and promised to reshape tomorrow industrial technologies. For example, data driven manufacturing will flourish efficient production systems by feeding IIoT data into a meaningful and productive decision-making model. Nevertheless, current data-driven models in IIoT (i.e., Deep Neural Networks, DNN) suffer from low usability of data caused by data incompleteness, low quality, insufficient quantity, sensitivity, etc. To name some, 1) handling uncertainty of input compromises overall decision-making performance; 2) training a well-functioned DNNs without large amounts of labelled data, which is expensive and rare in practical IIoT systems, results in unreliable and inaccurate models; 3) protecting private data in IIoT systems significantly sacrifices model utility. Deep Generative Models (DGMs) is a promising solution for solving the aforementioned issues as they can integrate the flexibility of DNNs and the inference power of probabilistic modeling, model the underlying distribution of the real data, and generate realistic "real" data in an unsupervised manner.
Though DGMs have already attracted a lot of attentions in IIoT, the limitations of the current design of DGMs, including the limited expressive power, insufficient interpretability, and weak discriminative capability, have imposed unique challenges that are yet to be well addressed, which is one of the major barriers to the widespread adoption of DGMs in many IIoT applications. To be specific, the network architecture and stringent requirement on input of DGMs limit the expressive power. DGMs require a non-linear black box to map a latent vector to high-dimensional data. However, the latent vector is hard to be interpreted due to its simple nature, and the semantic meaning of the generated data is difficult to capture even with auxiliary information. The existing DGMs fail to achieve the expected performance on sophisticated structured probabilistic models and completed unsupervised tasks (e.g., mode collapse of Generative Adversarial Networks). How DGMs can be practically extended to general data cases in IIoT where data are complex and heterogeneous in various scenarios imposed unique challenges. The goal of the special issue is to solicit high-quality and high-impact original papers aiming at demonstrating effective, efficient and practical DGMs to accommodate more sophisticated IIoT applications.

This special section will focus on (but not limited to) the following topics:

- Complex data structure generation with DGMs in IIoT
- Privacy-preserving data processing with DGMs in IIoT
- Private data publishing methods with DGMs in IIoT
- Data imputation and cleaning techniques with DGMs in IIoT
- Multi-source data fusion and integration of heterogeneous data with DGMs in IIoT
- Efficient and computation constrained DGMs for IIoT devices with limited battery power
- Distributed learning and federated learning integrated with DGMs
- DGMs on semi-supervised/supervised learning of IIoT scenarios
- DGMs on transfer learning, reinforcement learning, meta-learning, digital twins, etc.
- Convergence analysis on training stability, generalization capability, and discrimination power of DGMs
- Latent space and black-box structure of deep generative interpretation model
- Efficient algorithms and novel structures for learning and inference capability improvement
- Differentially private DGMs
- DGMs with probabilistic approximate correct learning
- Quantitative evaluation model for DGMs
- DGMs on non-independent and identically distributed dataset

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Submissions to this Special Section must represent original material that has been neither submitted to, nor published in, any other journal. Regular manuscript length is 8 pages.

Note: The recommended papers for the section are subject to final approval by the Editor-in-Chief. Some papers may be published outside the special section, at the EIC discretion.

Timetable: Deadline for manuscript submissions **February 25, 2021**
Expected publication date (tentative) October 2021

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