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Robust Diffusion Models for Anomaly Detection and Localization in High-Dimensional Data

Wednesday, 17 September 2025 12:30 (30 minutes)

Diffusion models have proven effective for generative modeling, denoising, and anomaly detection due to their ability to capture complex, high-dimensional, and non-linear data distributions. However, they typically require large amounts of non-anomalous training data, limiting their use when data is unlabeled and contains a mix of contaminated and uncontaminated samples. We propose a novel Robust Diffusion model that integrates robust statistical techniques to train diffusion models without relying on purely clean data. This approach enhances resilience to data contamination while preserving the model's learning capacity. Extensive simulations and a real-world case study show that our method consistently outperforms existing diffusion-based and statistical approaches across multiple anomaly detection metrics.

Special/ Invited session

Classification

Keywords

Presenter: PAYNABAR, Kamran (School of Industrial and Systems Engineering)

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