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Application of Diffusion models for remote sensing super resolution

This work explores the application of Denoising Diffusion Probabilistic Models (DDPMs) to super-resolution tasks in remote sensing imagery. Many research domains within Earth observation face a scarcity of high-quality data, largely due to the complexity and cost of acquiring satellite imagery. To address this challenge, we use Sentinel-2 data from the Copernicus Programme of the European Space Agency (ESA) as a testbed. Diffusion models are particularly attractive in this context because of their versatility: once trained for a specific task—such as image super-resolution—they can be adapted to related tasks with minimal architectural or code modifications. These models have already demonstrated strong potential in applications such as crop generation, cross-domain image translation (e.g., radar-to-optical), and a wide range of generative modeling scenarios.

In this study, we adopt the Latent Diffusion Model (LDM) framework, in which the diffusion process operates within the latent space of a Variational Autoencoder (VAE). Our results show that diffusion-based approaches offer a promising path for enhancing remote sensing data quality. Specifically, the proposed method successfully reconstructs satellite images at a spatial resolution of $10\text{ m} \times 10\text{ m}$ (100 m^2 per pixel) from inputs at $20\text{ m} \times 20\text{ m}$ resolution (400 m^2 per pixel), highlighting the potential of diffusion models for practical super-resolution applications in Earth observation.

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