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Cosmic Perspectives: A Comparative Study of Image-to-Image Translation Methods with an Emphasis on Geometrical Alignment

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Image-to-image translation is an important problem across various fields, including Cosmology and Astrophysics. The image-to-image translation can facilitate the unraveling the mysteries of the universe. While many empirical approaches have been proposed to address this problem, they often lack a solid theoretical basis that could generalize them.

In this work, we explore the image-to-image translation challenge, focusing on predicting future satellite Webb-images using existing Hubble-images. We benchmark several translation methods including Pix2Pix, CycleGAN, and the DDPM-model based Palette.

We introduce 'Turbo,' a novel image-to-image translation framework that combines features from both paired and unpaired approaches. Turbo generalizes these methodologies by emphasizing the critical role of synchronization between image pairs in translation tasks.

We propose a framework that leverages the stochasticity of the DDPM to measure uncertainty in image-to-image translation. This framework adds a layer of robustness and applicability, especially in the context of astronomical image-to-image translation.

Our comparative analysis utilizes a comprehensive suite of metrics, including MSE, SSIM, PSNR, LPIPS, and FID, comparing the effectiveness and efficiency of our proposed methods.

This study is a step forward in image-to-image translation, combining theory and practical uses. We improve computer vision methods and also advance use of deep learning in Astrophysics.

Brainstorming idea [title]

Image-to-image translation using DDPMs in the Cosmology and Astrophysics

Brainstorming idea [abstract]

The primary objective is understand the potential of DDPMs in enhancing, refining, and translating astronomical images into meaningful visual representations that can further the understanding of the universe. The challenges include data sparsity, noise in cosmic imagery, data synchronization and the need for accurate translations in celestial studies.

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