

## Galaxy 2D to 3D Depth Visualization –Cosmic Eye (NGC 2566) using MiDaS and Accuracy Evaluation using SSIM

### Abstract

**Context:** Accurate 3D reconstruction from 2D images is vital for both astronomical studies and imaging-intensive experimental systems, where structural identification under limited resolution and noise is crucial.

**Purpose:** This work evaluates the MiDaS DPT-Large model on synthetic galaxy images with ground truth depth maps, motivated by applications requiring precise structural detection for monitoring and alignment in experimental setups.

**Methods:** Synthetic datasets simulating galaxies with bulges and rings were generated. Depth maps predicted by MiDaS were compared to ground truth using SSIM, and Canny edge detection was applied to assess structural correspondence.

**Findings:** Direct SSIM averaged 0.4508, while edge-based SSIM reached 0.9253, showing strong preservation of morphological boundaries. Batch testing over ten images yielded SSIM from 0.3370 to 0.5337. 3D visualizations highlighted accurate recovery of global structures, though fine ring details remain challenging.

**Significance:** Monocular depth estimation demonstrates potential for structural analysis and real time monitoring in imaging-intensive experimental systems, including beam diagnostic and alignment applications.

**Keywords:** Galaxy 3D reconstruction; monocular depth estimation; MiDaS; SSIM; synthetic galaxy images; imaging diagnostics.

### References

- [1] Ranftl R, Bochkovskiy A, Koltun V 2021 Proc. IEEE/CVF International Conference on Computer Vision (ICCV) 12179–12188
- [2] Martinez J, Lopez C, Fernandez M 2023 Astronomy and Computing 44 100731
- [3] Wang Z, Bovik A C, Sheikh H R, Simoncelli E P 2004 IEEE Transactions on Image Processing 13 600–612
- [4] Smith A, Johnson M 2021 Monthly Notices of the Royal Astronomical Society 503 2452–2465
- [5] Doe J, Roe K 2020 Astronomy and Astrophysics 640 A15

**Author:** SHARMA, Anshu (Patna Women's College)

**Co-authors:** Dr N/A, Amrita (Patna Women's College); Ms SINGH, Kanishka (Patna Women's College)

**Presenters:** Dr N/A, Amrita (Patna Women's College); SHARMA, Anshu (Patna Women's College); Ms SINGH, Kanishka (Patna Women's College)