DeepDISC: Deep Learning-Driven Deblending Using Overlapping Rubin and Roman Data

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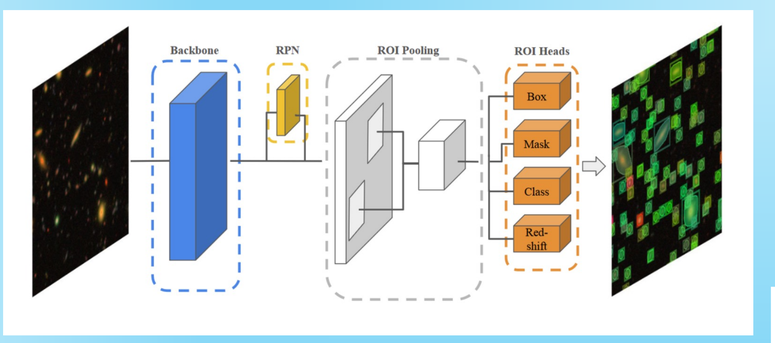
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GitHub Code:



Motivation

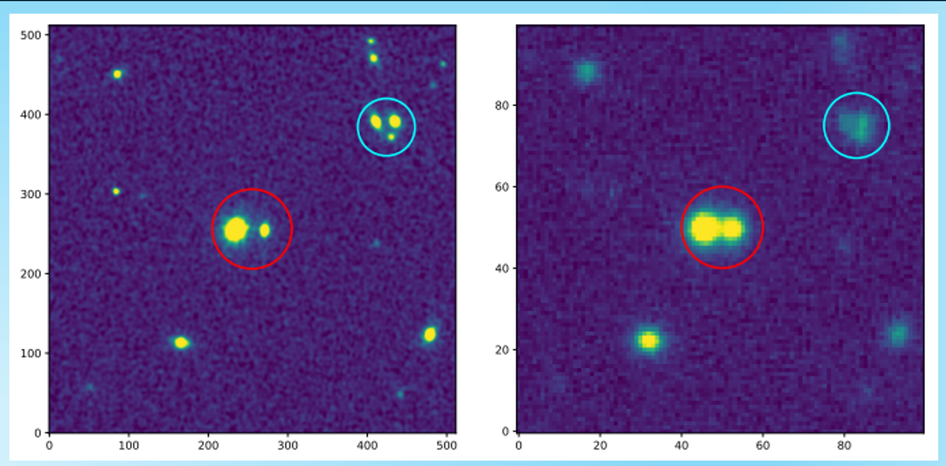
- **Blending,** multiple sources overlapping in images, leads to **biased measurements** contaminating key inferences such as photometry[1], galaxy clustering[2], and weak gravitational lensing[3]
  - **Unrecognized blends** (multiple sources detected as single source) are especially problematic since many deblenders rely on *initial source detection*
  - Introduces **large errors** in flux, redshift, shape, color measurements affecting downstream analyses
- Traditional methods identify unrecognized blends *after catalog creation* using anomaly detection while **DeepDISC[4]** uses deep learning instance segmentation to detect, classify, and deblend sources directly from raw pixels reducing the number of unrecognized blends from the start



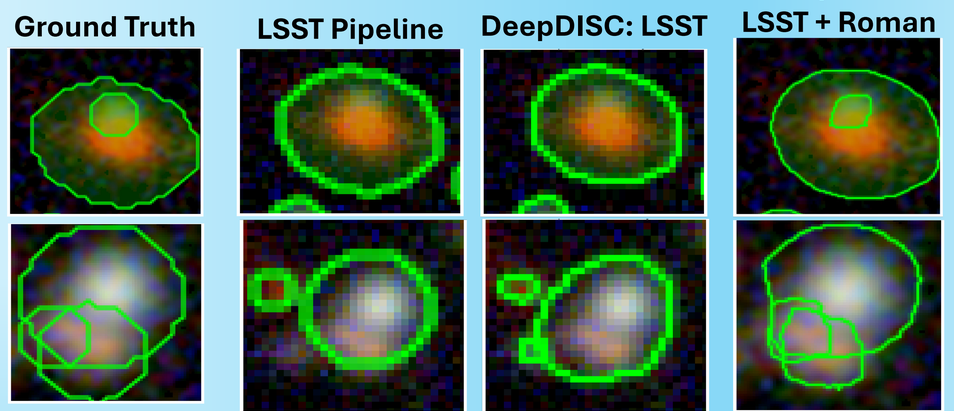
High-level diagram of the DeepDISC architecture[4]

Joint-Survey Data

- DESC DC2[6] simulated coadds at 5yr LSST depths (*ugrizy*)
- Troxel 2023[7] simulated coadds at full 5yr depth of Roman's High Latitude Imaging Survey
  - **20 sq. deg of overlap** with DC2 simulated data
- Train Swin Transformer backbone on LSST and LSST + Roman with ~3k images containing ~200k objects
- Ground truth segmentation masks created by simulating **multi-band object profiles** using GalSim and information from the truth catalogs
  - **Matched filtering** with a fiducial PSF and thresholding above background level
- Segmentation mask where 0 pixels above threshold or is less than 12 pixels → source is ignored



Overlapping regions from Roman H158-band (left) and LSST i-band (right) coadds[5]



Results

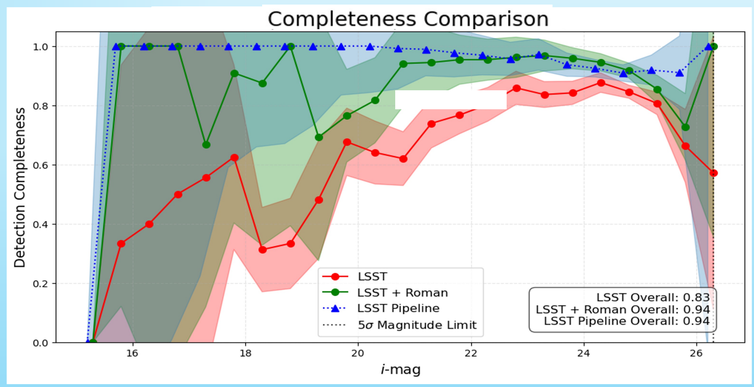
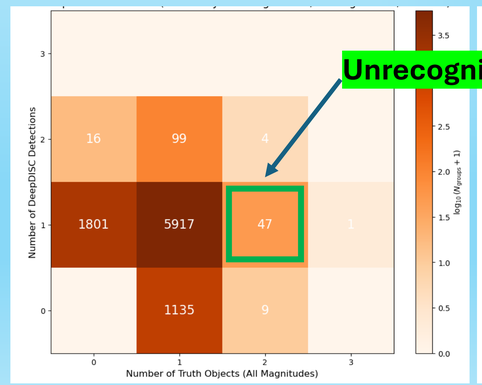


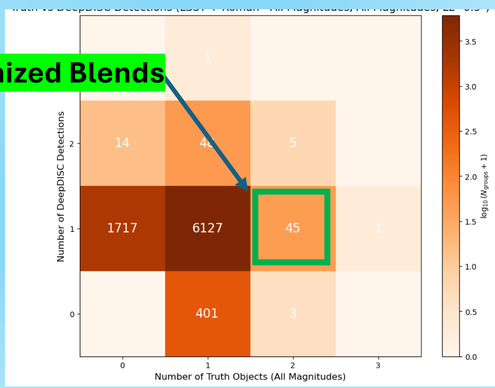
Table 1: Overall Unrecognized Blend Fractions (UBF) for Detection Catalogs vs. LSST Truth

Catalog	UBF	N_{blended}	$N_{\text{total matched}}$
LSST Pipeline (LSST Only, Truth Ref)	0.0090 ± 0.0011	61	6762
DeepDISC (LSST Only, Truth Ref)	0.0077 ± 0.0011	47	6098
DeepDISC (LSST+Roman, Truth Ref)	0.0073 ± 0.0011	45	6146

DeepDISC: LSST – LSST Truth vs Our Detections



DeepDISC: LSST + Roman – LSST Truth vs Our Detections



References

[1] Boucaud et al. 2020
[2] Levine et al. 2025
[3] Dawson et al. 2016
[4] Merz et al. 2023
[5] OpenUniverse et al. 2024
[6] DESC et al. 2021
[7] Troxel et al. 2023