

University of Groningen

Automating the detection of strong gravitational lenses in large-scale surveys using deep learning

Nagam, Bharath Chowdhary

DOI:

[10.33612/diss.1187888207](https://doi.org/10.33612/diss.1187888207)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2025

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Nagam, B. C. (2025). *Automating the detection of strong gravitational lenses in large-scale surveys using deep learning*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen.
<https://doi.org/10.33612/diss.1187888207>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Propositions

accompanying the dissertation

AUTOMATING THE DETECTION OF STRONG GRAVITATIONAL LENSES IN LARGE-SCALE SURVEYS USING DEEP LEARNING

by

Bharath Chowdhary NAGAM

1. The rapid growth in astronomical survey data, particularly from missions like Euclid surveying up to 2 billion galaxies, necessitates automated methods that complement traditional human inspection for identifying rare objects (this Thesis).
2. DenseNet can achieve comparable performance to ResNet architectures in gravitational lens detection while requiring fewer parameters and achieves lower training error in comparably less training steps.(Chapter 2).
3. The Information Content metric provides a more reliable method for ranking lens candidates than classification probability alone (Chapter 2).
4. Segmentation algorithms, when combined with classification scores, can significantly reduce false positives while maintaining high detection efficiency for strong gravitational lenses (Chapter 3).
5. Denoising Diffusion Generative Adversarial Networks can generate realistic mock-images, providing an additional tool for expanding training datasets (Chapter 4).
6. Based on the discovery rate of strong lenses in Euclid ERO data, at least 5,500 strong lenses could be readily discovered in the complete Euclid survey without human intervention (Chapter 5).
7. The automation of astronomical discovery processes must balance efficiency with reliability, as false positives remain a significant challenge even in state-of-the-art automatic classification systems.
8. The future of large-scale astronomical surveys depends on our ability to develop robust automated classification systems that can process data faster and more reliably than human inspection allows.
9. Machine learning in astronomy represents a paradigm shift from traditional visual inspection to accelerate discovery of strong lenses.
10. Technical excellence combined with clear communication drives successful scientific collaboration.