

## DeepTrack2: High-Quality Microscopy Simulations for Deep Learning

Mirja Granfors<sup>1,\*</sup>, Alex Lech<sup>1</sup>, Benjamin Midtvedt<sup>1</sup>, Jesús Pineda<sup>1</sup>, Harshith Bachimanchi<sup>1</sup>, Carlo Manzo<sup>2</sup>, Giovanni Volpe<sup>1</sup>

<sup>1</sup> Department of Physics  
University of Gothenburg  
Origovägen 6B, 41296 Gothenburg, Sweden

<sup>2</sup> Universitat de Vic  
Universitat Central de Catalunya  
Sagrada Família 7, 08500 Vic, Spain

### Abstract

DeepTrack2 is a flexible and scalable Python library designed for simulating microscopy data to generate high-quality synthetic datasets for training deep learning models [1]. It supports a wide range of imaging modalities, including brightfield, fluorescence, darkfield, and holography, allowing users to simulate real experimental conditions with ease. Its modular architecture enables users to customize experimental setups, simulate a variety of objects, and incorporate optical aberrations, realistic experimental noise, and other user-defined effects, making it suitable for various research applications. DeepTrack2 is designed to be a powerful yet accessible tool for researchers in fields that utilize image analysis and deep learning, as it eliminates the need for labor-intensive manual annotation. This helps accelerate the development of AI-driven methods by providing largescale, high-quality data that is often required by deep learning models. DeepTrack2 has already been used for a number of applications in cell tracking, classifications tasks, segmentations and holographic reconstruction. Its flexible and scalable nature enables researchers to simulate a wide array of experimental conditions and scenarios with full control of the features. DeepTrack2 is available on GitHub, with extensive documentation, tutorials, and an active community for support and collaboration [2].

### References

- [1] B. Midtvedt, S. Helgadottir, A. Argun, J. Pineda, D. Midtvedt, G. Volpe (2021). Quantitative Digital Microscopy with Deep Learning. *Applied Physics Reviews*, volume 8, article number 011310.
- [2] <https://github.com/DeepTrackAI/DeepTrack2>

---

\*Corresponding author: mirja.granfors@physics.gu.se