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The six main tasks in image processing: an overview

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Modern imaging methods enable us to capture structure and dynamics in unprecedented detail and with high temporal and spatial resolution. The challenge is to make full use of the potential of such "big" imaging data to obtain quantitative results, test hypotheses, and develop new theories and models. Manual or semi-automated image analysis workflows quickly become a bottleneck because they do not scale well with the amount and complexity of the data. This lecture provides an overview of typical automated image analysis workflows using examples from high-resolution microscopy in the life sciences. We will cover the six main tasks, including image reconstruction from raw tomography or localization data, denoising, tracking in time and space, segmentation to extract objects from images, visualization, and explainable AI-based methods. In the last part, we will introduce tools for integrating these different tasks into complete workflows.

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