Automated laser microdissection for studying spatial biology

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Abstract

Multiomics study in spatial context is a crucial aspect for understanding diverse biological processes in healthy or diseased conditions. Different approaches are available and can be roughly grouped to in situ and ex situ techniques. For all the ex situ studies, effective collection of clean material down to single cell level without mixing their molecular information with neighboring cells is essential. Laser Microdissection (LMD) technique utilizes a highly precise way to prepare samples for those downstream ‘omics analyses. With the demand of large number of materials for statistics, automated collecting in LMD system will be highly appreciated.

The Matthias Mann lab has developed a groundbreaking method (ref.) called Deep Visual Proteomics (DVP) that combines Laser Microdissection (LMD) with ultra-high sensitivity mass spectrometry to deliver molecular insights with spatial context on a cellular level. In this new approach, Artificial Intelligence (AI) is used in conjunction with LMD to increase discovery throughput. Cells of a defined phenotype are discovered automatically and can be marked for subsequent isolation. Coordinates of the marked cells are imported to the LMD and dissected precisely. With this technique, they show retaining spatial information in the tissue context is important for molecular profiling of clinical samples.

In this workshop we will use the Leica LMD system to demonstrate a workflow of automatic laser microdissection with help of AIVIA AI-supported object recognition. Images of the sample from any imaging technique can be analyzed with AIVIA and the contour of found objects will be saved in an LMD-compatible file. LMD will then batch process those objects and collect them separately or in predefined groups. You will see a great ease of work and additional time saving for ‘omics sample preparation. In this way, the LMD workflow can build a bridge between the upstream imaging facilities with the downstream ‘omics facilities.

References

1. Mund et al., Nature Biotechnology, 2022. https://doi.org/10.1038/s41587-022-01302-5
2. Rosenberger et al., BioRxiv, 2022. https://doi.org/10.1101/2022.12.03.518957