Intelligent Image-Activated Cell Sorting
: Principles and Application to Hematology

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In this talk, I introduce an intelligence technology reported as “Intelligent Image-Activated Cell Sorting (iIACS)” [Nitta et al., Cell 175, 266 (2018); Isozaki et al., Nature Protocols 14, 2370 (2019)] that builds on a radically new architecture that realizes real-time image-based intelligent cell sorting at an unprecedented rate. This technology integrates high-throughput cell microscopy, focusing, sorting, and deep learning on a hybrid software-hardware data-management infrastructure, enabling real-time automated operation for data acquisition, data processing, intelligent decision-making, and actuation. Recently, we reported an upgraded version of the iIACS machine that far surpasses the state-of-the-art iIACS machine in system performance for expanding the range of applications and discoveries enabled by the technology [Isozaki et al., Lab on a Chip 20, 2263, (2020)]. Specifically, the upgraded iIACS machine provides a high sensitivity of ~50 molecules of equivalent soluble fluorophores (MESFs) and a high throughput of 2,000 events per second. I introduce the details of its principles in this talk. Furthermore, we are applying this technology to diverse applications, such as microbiology, cancer biology, immunology, hematology, and synthetic biology. I introduce some of these applications conducted in our laboratory.