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ABSTRACT BOOK

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Title: Developing microfluidic techniques for biochemical and medical applications

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FNP programme: FIRST TEAM

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Our group aims to develop microfluidic techniques, improving their precision and applicability in biology and medicine. We cooperate with biological and medical groups to develop microfluidic devices customized for the particular research requirements of our collaborators. A successful example of the development of such a biological-oriented design is our microfluidic system, enabling spatial and temporal control over the formation of tension gradients arising from epithelial monolayer deformation. Another system developed in our laboratory allows for estimating the gas-handling properties of red blood cells by using single-cell oxygen saturation imaging. Recently, in collaboration with Prof. Przemysław Juszczyński's group, we have been elaborating on a system with single cell traps. That system is envisioned to manipulate three types of cells, enabling interactions between single cells within a defined sequence. This work aims to investigate the mechanism responsible for developing the immunosuppressive microenvironment in lymphomas and therapeutic approaches to reprogram its functions. A vast part of our activities is devoted to droplets in microfluidic channels. Each droplet in the microfluidic channel is equivalent to a tiny reactor that can include samples, reagents, or biological components for chemical synthesis, analytical assays, biological processes, drug discovery, and more. In these and other applications, obtaining the concentration of a given reagent in a precise, accurate, and above all, reproducible manner is paramount. We developed unique microfluidic geometries for the passive manipulation of droplets and sequential logic devices for the controlled permutations of droplets within the sequence. Then we used digital algorithms that ensure superior accuracy, repeatability, and flexibility in concentration settings through a series of operations of selective merging and splitting droplets into equal parts.