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Engineering Approaches for Biomedical Applications

Engineers can actively contribute to fields thought to be out of their “comfort zones”. They can be leaders of discoveries that translate into advances in the understanding of disease and improving human health. Engineers might use different language and tools than Life Sciences Scientists but can find a common ground, as the laws of Thermodynamics, Physics, and Mathematics also apply to biological phenomena.
The development of microbioreactors (μBRs) reconstructing biologically sound niches can thus revolutionize medical research.
In our bodies cells reside in a complex milieu, the microenvironment (μEnv), regulating their fate and function. Most of this complexity is lacking in standard laboratory models, leading to readouts poorly predicting the in vivo situation. This is particularly felt in cancer research, as tumors are extremely heterogeneous and capable of conditioning both the local μEnv and distant organs. We hypothesize that μBRs exploiting classical engineering principles will solve the limitations of existing classical culture models. We propose to develop platforms and to test their edge over classical approaches in answering to specific biological questions. Our μBRs generate time and space-resolved concentration gradients, support fast dynamic changes and reconstruct complex interactions between cells and tissues while performing multifactorial and parallelized experiments.
We expect that our technologies, paired with strong mathematical approaches to analyze and interpret our data, will bridge the gap between in vitro techniques and in vivo biological phenomena leading to significant and novel results, shedding light on previously unexplored scenarios.

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