VolkswagenStiftung

Combining SYnthetic Biology & Neuromorphic Computing for CHemosensory perception (SYNCH)

Initiative: NEXT

Ausschreibung: Neuromorphic Computing

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Like the human brain, neuromorphic computing relies on data sampled from the outside world. In the human brain, sensory neurons provide information about light, touch, sounds, taste, and smell. Using synthetic biology, we want to equip artificial microelectronic systems with one of these senses: the sense of smell, or olfaction. Biological olfaction outperforms traditional chemical technologies in detection limit, specificity, response time, coding capacity, robustness, size, and power consumption. This outstanding performance is mainly due to the unique architecture of the olfactory pathway that has evolved over millions of years in all living species, from tiny insects to large mammals, and has produced membrane proteins with specialized channels that selectively recognize odor molecules. These naturally selective interactions are entry points to biological signaling. Today, the field of synthetic biology can engineer an artificial version of such entry points with the goal to fully control and leverage the abilities of biological systems. Moreover, neuromorphic electronic circuits can replicate biological neural systems' computational properties using microelectronic devices and emerging nanomaterials' physical properties. Thus, we aim to develop an integrated platform for chemical sensing by integrating, for the first time, neuromorphic electronic systems coupled with synthetic biological mediums. Specifically, SYNCH aims to co-design synthetic biological pathways, neuromorphic electronic circuits, and bio-constrained multichannel decoding algorithms to create an accurate and efficient neuromorphic chemical perception system inspired by the natural olfactory system. Furthermore, we aim to realize real-time decoding of biological interactions generated by a range of small molecules through temporal spiking data for fast, distributed, and online chemosensing identification and classification.

Projektbeteiligte

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