The MainSTREAM Component Platform: A Holistic Approach to Microfluidic System Design

A microfluidic component library for building systems driving parallel or serial microfluidic-based assays is presented. The components are a miniaturized eight-channel peristaltic pump, an eight-channel valve, sample-to-waste liquid management, and interconnections. The library of components was tested by constructing various systems supporting perfusion cell culture, automated DNA hybridizations, and in situ hybridizations. The results showed that the MainSTREAM components provided (1) a rapid, robust, and simple method to establish numerous fluidic inputs and outputs to various types of reaction chips; (2) highly parallel pumping and routing/valving capability; (3) methods to interface pumps and chip-to-liquid management systems; (4) means to construct a portable system; (5) reconfigurability/flexibility in system design; (6) means to interface to microscopes; and (7) compatibility with tested biological methods. It was found that LEGO Mindstorms motors, controllers, and software were robust, inexpensive, and an accessible choice as compared with corresponding custom-made actuators. MainSTREAM systems could operate continuously for weeks without leaks, contamination, or system failures. In conclusion, the MainSTREAM components described here meet many of the demands on components for constructing and using microfluidics systems.

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