Developing Robust Synthetic Biology designs using a Microfluidic Robot Scientist

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ABSTRACT:

Synthetic Biology is an emerging discipline that is providing a conceptual framework for biological engineering based on principles of standardisation, modularity and abstraction. For this approach to achieve the ends of becoming a widely applicable engineering discipline it is critical that the resulting biological devices are capable of functioning according to a given specification in a robust fashion. In this talk we will describe the development of techniques for experimental validation and revision based on the development of a microfluidic robot scientist to support the empirical testing and automatic revision of robust component and device-level designs. The approach is based on probabilistic and logical hypotheses [1] generated by active machine learning. Previous papers [2,3] based on the author's design of a Robot Scientist appeared in Nature and was widely reported in the press. The new techniques will extend those in the speaker's previous publications in which it was demonstrated that the scientific cycle of hypothesis formation, choice of low-expected cost experiments and the conducting of biological experiments could be implemented in a fully automated closed-loop. In the present work we are developing the use of Chemical Turing machines based on micro-fluidic technology, to allow high-speed (sub-second) turnaround in the cycle of hypothesis formation and testing. If successful such an approach should allow a speed-up of several orders of magnitude compared to the previous technique (previously 24 hour experimental cycle).