Synthetic Biology design automation tool suite

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Project Goals:

Our work collectively aims to reduce the time and cost required to pursue large scale cloning and DNA construction tasks, as well as to enable research scales otherwise unfeasible without the assistance of biological design automation software tools and process automation devices.

The production of clean renewable biofuels from cellulosic starting material requires concerted feedstock engineering, deconstruction of plant matter into simple sugars, and microbial fermentation of the sugars into biofuel. These three efforts share significant biological design and execution challenges, including the construction of large combinatorial libraries of engineered enzyme-variants and metabolic pathways. Towards addressing these challenges, we have developed a suite of foundational enabling technologies that include an on-line genetic component repository (JBEI-ICE), web-based biological design automation software tools (DeviceEditor, j5, and DNA Constructor), and an open-source biology-friendly robot programming language (PaR-PaR). JBEI-ICE is an open-source distributed platform that unifies and simplifies how genetic components are stored and managed. DeviceEditor offers a visual design canvas for spatially arranging abstractions of these genetic components, and integrates with j5 to automate the cost-optimal design of scar-less, multi-part DNA construction protocols to assemble the components together. DNA Constructor designs optimized protocols for hierarchically constructing related DNA molecules from DNA oligos, providing access to DNA sequences not yet physically available in JBEI-ICE. j5 and DNA Constructor exploit PaR-PaR to integrate with liquid-handling robotic platforms that automate the set up PCR and DNA assembly reactions.

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