CASE STUDY

WISCONSIN UNIVERSITY OF WISCONSIN-MADISON + strateos

Accelerating Protein Engineering Through Lab Automation and Artificial Intelligence

GOAL: Leverage lab automation and AI to establish a closed-loop and reproducible design-make-test-learn cycle to accelerate the conventional long process of protein engineering

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The Romero Lab at the University of Wisconsin-Madison focuses on design principles of proteins and how they can be engineered with new molecular functions to solve challenging problems in various fields. The team has developed an innovative AI-driven protein design platform, but traditional methods for testing the designed proteins are often manual and slow, with poor reproducibility and inadequate data acquisition. These experimental bottlenecks limit the speed of mapping the sequence-function landscape to identify proteins with desirable molecular functions. Integrating their discovery algorithm with Strateos' automated robotic cloud lab enabled the creation of a fully autonomous, high throughput discovery and testing system to rapidly identify promising engineered proteins.

CLIENT CHALLENGES

- **Millions of potential sequence variations are possible even for the simplest protein, necessitating a faster, more reproducible platform to execute the design-make-test-learn loop**
- **Iterative assays involved in testing protein constructs, such as DNA assembly, protein expression, and functional assays, are laborious and time consuming**
- **Traditional experimental methods are highly manual resulting in lack of reproducibility and poor sample/scientific data acquisition and tracking**

CLIENT RESULTS

*into UW's Protein Engineering Platform

- **32X** Increase in Output Scale
- **7 Hours** Hands-On Time Freed Up per Sequence
- **6 Hours** vs. 8 Days per Design to Data Cycle
- **5** Protocols Automated and Integrated*

CASE STUDY

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THE FULL STORY

The Romero Lab at the University of Wisconsin-Madison has developed an AI-driven protein design platform capable of processing and interpreting a vast quantity of sequence data to quickly make inferences to refine designs in an iterative manner. Conventional protein engineering is long and laborious, involving repetitive and iterative cycles of protein design followed by synthesis and functional testing of vast protein sequence permutations to find a promising protein with desired molecular functions. While the Romero lab's technology greatly accelerated the design process, bottlenecks in the synthesis, functional testing, and data acquisition phases remained cumbersome and inconsistent.

Strateos' expertise in assay design and the on-demand automated cloud labs enabled integration of multistep, iterative protocols into a single reliable, reproducible automated workflow that could connect to the AI-driven protein design platform. Through these efforts, researchers from Romero's lab could customize parameters (i.e., number of vectors and chemical inputs) and execute experiments remotely via the integrated user interface and/or programmatically through the Strateos API. Agile, real-time sample and metadata tracing and standardized data acquisition fed results into their AI design model, continuing the iterative design-make-test-learn loop at unprecedented speed.

Strateos implemented five key protocol stages pivotal to the Romero lab's design-make-test-learn process into the automated cloud lab to overcome reproducibility and throughput challenges. The steps included DNA assembly via Golden Gate, PCR amplification, IVTT, PCR checkpoint via EvaGreen, and characterization of protein functionality via thermal stability assays. By establishing a contiguous high throughput experimental framework, each sequence measurement is completed in 6 hours with zero hands-on time required, freeing up 7 days with 7 hours of hands-on time and increasing overall output by 32x . Leveraging Strateos' platform also allowed the testing to be done without incurring any capital equipment expenditures and allowed personnel resources to be better allocated to focus on more critical tasks, such as protein design and hypothesis generation.

Protein Engineering Protocols Automated in the Strateos™ Platform

Golden Gate DNA Assembly | PCR Amplification | Cell Free IVTT | PCR Checkpoint Analysis | Protein Thermal Stability

THE FULL STORY - continued

The integration of Strateos' lab automation with Romero lab's protein design model establishes a fully autonomous and continuous protein engineering workflow. The flexibility afforded by the modular design enables future reconfigurations and repurposing to adapt to evolving needs of research labs. This powerful new breed of laboratories driven by computation, AI, automation, and high-throughput robotics can generate clean, actionable data at a rate that outpaces today's artisan (and mostly manual) methods to help researchers fully realize the potential of protein engineering.

"This partnership has worked out really well. Strateos' specialized knowledge of robotics and automation has freed up time for us to focus on AI-based protein design"

– Philip Romero, PhD, Assistant Professor at UW