

Alexander C. Reis

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Education

Pennsylvania State University

Ph.D. Department of Chemical Engineering, Fall 2020. Thesis: Sequence Level of Evolutionary-Robust Genetic Systems.

University Park, PA

Rice University

B.S. Department of Chemical and Biomolecular Engineering, Spring 2014. Design Project: Design of a Mobile Bio-Fuel Plant to Convert Algae into Natural Gas.

Houston, TX

Research

Pennsylvania State University

Advisor: Howard M. Salis

Studied sequence-level design of genetic systems for synthetic biology applications. Developed a new sequence-function biophysical model of translation initiation in bacteria for improved precision control of protein expression. The new model, the Ribosome Binding Site (RBS) Calculator v3.0, was developed using an automated model test system and a compiled database of 9,862 characterized mRNA variants. This work included a detail statistical analysis and comparison of six existing sequence-function models of translation rate and a “safe design space” that directs the RBS Calculator design algorithm to avoid RBS variants with physical properties associated with increased model error. Separately, I studied scalable sequence-level design of multiplex CRISPR interference (CRISPRi) in *E. coli*. This project demonstrated how nonrepetitive DNA sequence design can enable direct synthesis and genetically stable expression of extra-long sgRNA arrays (ELSAs) for synthetic biology applications. A learn-by-design approach that leveraged machine learning and fluorescence measurements allowed us to design over two dozen highly functional nonrepetitive single-guide RNAs (sgRNAs) for use in ELSAs. Other experimental approaches used in this work include LC-MS, HPLC, RNA-seq, electrophoretic mobility shift assays (EMSA), and colony counting to determine persister cell counts following antibiotic treatment. (January 2015 - December 2020)

University Park, PA

Experience

Synergistic Discovery & Design (SD2), DARPA

Program Head: Jennifer Roberts

Supported highly collaborative research developing algorithms, tools and frameworks toward accelerating synthetic biology research for DARPA-relevant applications. Performed as a “TA1” analyst and “TA2” experimental design researcher. Collaborated with experimental groups (Ginkgo Bioworks, University of Washington BIOFAB, Transcriptic/Strateos), infrastructure teams (Texas Advanced Computing Center, TACC), and other analyst and design groups to conduct informative experiments to drive machine-learning from data collected at the petabyte scale.

Glycos Biotechnologies, Inc.

Advisors: Ryan Black, Werner Bussmann, Paul Campbell

Houston, TX

Studied conversion of glycerol and Palm Fatty-Acid Distillate (PFAD) to isoprene with the mevalonate pathway in *Escherichia coli* with bench-scale fermentation experiments and computational flux balance analysis. Performed 24-hour, half-liter fermentations followed by LC/GC-MS of engineered strains on assorted feedstocks. Studied the effect of knockouts of non-essential metabolic reactions using a custom flux balance analysis model of central metabolism. (June 2012-December 2013)

Publications **Reis, A. C., & Salis, H. M. (2020).** An automated model test system for systematic development and improvement of gene expression models. *ACS Synthetic Biology*. <https://doi.org/10.1021/acssynbio.0c00394>

Reis, A. C., Hossain, S. A., & Salis, H. M. (2020). A massively parallel COVID-19 diagnostic assay for simultaneous testing of 19200 patient samples. Google Docs, Mar.

Hossain, A., Lopez, E., Halper, S. M., Cetnar, D. P., **Reis, A. C.**, Strickland, D., ... & Salis, H. M. (2020). Automated design of thousands of nonrepetitive parts for engineering stable genetic systems. *Nature biotechnology*, 1-10.

Reis, A. C., Halper, S. M., Vezeau, G. E., Cetnar, D. P., Hossain, A., Clauer, P. R., & Salis, H. M. (2019). Simultaneous repression of multiple bacterial genes using nonrepetitive extra-long sgRNA arrays. *Nature biotechnology*, 37(11), 1294-1301.

Presentations Reis, A. C., Halper, S. M., Vezeau, G. E., Cetnar, D., Hossain, A., Clauer, P. R., and Salis, H. M., Simultaneous regulation of many genes using highly nonrepetitive extra-long sgRNA arrays (ELSAs). Synthetic Biology: Engineering, Evolution & Design (SEED), New York, NY, 2019

Reis, A. C., Halper, S. M., Vezeau, G. E., Cetnar, D., Hossain, A., Clauer, P. R., and Salis, H. M., Simultaneous regulation of many genes using highly nonrepetitive extra-long sgRNA arrays (ELSAs). Engineering Biology Research Consortium (EBRC), Fort Collins, CO, 2018

Reis, A. C., Halper, S. M., Vezeau, G. E., Cetnar, D., Hossain, A., Clauer, P. R., and Salis, H. M., Simultaneous regulation of many genes using highly nonrepetitive extra-long sgRNA arrays (ELSAs). Annual AIChE Meeting, Pittsburgh, PA, 2018

Reis, A. C., Halper, S. M., Vezeau, G. E., Cetnar, D., Hossain, A., Clauer, P. R., and Salis, H. M., Evolutionary-Robust, Many-Regulator CRISPR Arrays for Large-Scale Reprogramming of Metabolism and Cellular Physiology. AIChE CRISPR Technologies Conference, Raleigh, NC, 2017

Reis, A. C., Eslami, M., Motta, F., Mirian, V., Chuah, J. Y., Roehner, N., Maschhoff, P., Marques, J., and Maheshri, N., Engineering a protease-knockout *Bacillus subtilis* strain for DoD-relevant applications. SD2 Data Analysis Hackathon and Integration Workshop, Arlington, VA, 2017

Reis, A. C., Salis, H. M., An automated model test system for systematic development of gene expression models. International Workshop on Biodesign Automation (IWBD), Pittsburgh, PA, 2017

Reis, A. C., Salis, H. M., An open-sourced 16651 mRNA sequence-expression database for systematic testing of gene expression models. Annual AIChE Meeting, San Francisco, CA, 2016

Reis, A. C., Salis, H. M., Deciphering the biophysical determinants of translation using an open-sourced database of 16651 mRNA sequences. Synberc Retreat, Berkeley, CA, 2016

Teaching Experience **Pennsylvania State University, Chemical Engineering** University Park, PA
Introduction to Biomolecular Engineering, Guest Lecturer

Rice University, Student Taught Course Houston, TX
Virtual Design and Architecture: Competitive Halo Map Design in Forge, Instructor

Awards & Service Best Energy-Related Engineering Design Award, Rice University (2014)
Duncan College Masters Award, Rice University (2014)
Duncan College Academics Committee, Founder & Chair (2012-2014)
Peer Academic Advisor, Rice University (2011-2013)
Undergraduate Research Mentor, Pennsylvania State University (2015-2020)
Mentor, iGEM (Internationally Genetically Engineered Machine) Competition (2014)
Lab Courier, Dell Children's Medical Center of Central Texas (2010)

Activities Rice Crew, President (2010-2014)

References	Howard M. Salis Ag. Bio. Engineering Chemical Engineering Penn State University 105 Ag. Eng. Bldg. University Park, PA 16802 814-865-1931 salis@psu.edu	Phillip Savage Chemical Engineering Head & Walter L. Robb Chair Penn State University 121D Chem. Eng. Bldg. University Park, PA 16802 814-867-5876 pes15@psu.edu	Philip Bevilaqua Chemistry Department Head Penn State University 242 Chemistry Bldg. University Park, PA 814-863-3812 pcb5@psu.edu
	Deepak Nagrath Biomedical Engineering University of Michigan NCRC, Bldg. 28, 3048W 2800 Plymouth Rd. Ann Arbor, MI 48109 734-764-9889 dnagrath@umich.edu	Luis Duno-Gottberg Department of Spanish, Portuguese & Latin American Studies Rice University 316 Rayzor Hall Houston, TX 77251 713-348-5451 Luis.Duno-Gottberg@rice.edu	