SynBERC

Synthetic Biology Engineering Research Center

Making biology easier to engineer.

Synthetic Biology
Tools for Industrial Biotechnology

Peter Ackermann

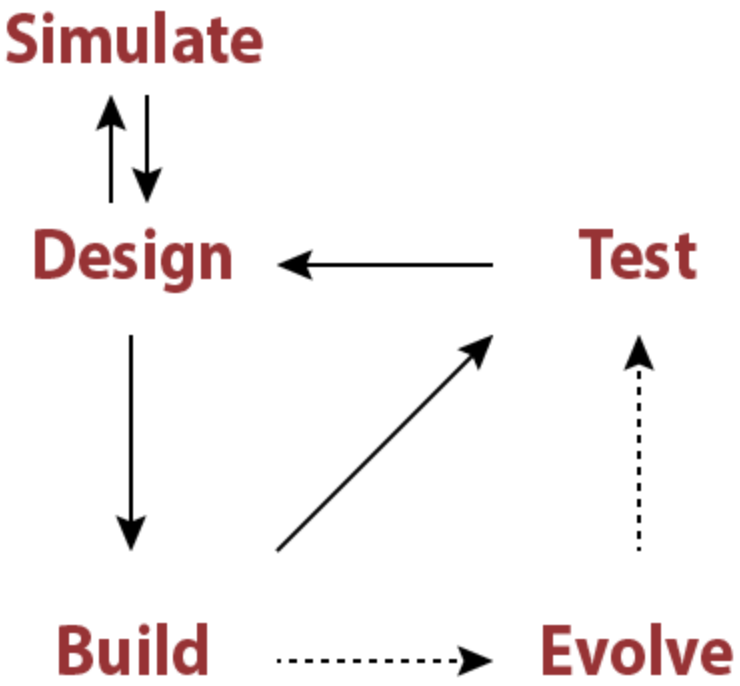
Synthetic biology?

Engineering biology.

Applying the principles of…

- design
- abstraction
- composability
- standardization
- characterization

…to biological systems.



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SynBERC at a glance

UCB Harvard MIT Stanford UCSF

- 5 core institutions
- 30 professors & labs
- 25 industry members
- advisory board
- 2 retreats / year
  2½ days of cutting-edge science

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SynBERC industry members

***SynBERC start-ups**

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Why are they members?

- Learn, acquire tools and know-how
- Connect with academics and industry
- Recruit talent
- Access infrastructure
  - SynBERC registry, members-only website
- Identify opportunities
  - Needs, markets, synergies
- Take cover
  - Best practices: safety, security, ethics
  - Public engagement, education
- Influence SynBERC research directions

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Tools

Design (CAD)

- Parts registries
- Sequence handlers, calculators, debuggers
  - Clotho, RBS calculator
- Robust, context-independent, tunable expression
  - Bicistronic design + calculator
  - BioFAB Expression Operating Unit (EOU)
  - Used by Ginkgo Bioworks
- Protein engineering
  - RosettaBackrub: protein structure modeling

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Tools

Build (CAM)

- Liquid-handling robots + control software
- DNA synthesis and assembly
  - j5 (JBEI / TeselaGen)
- Genomic installation of large DNA constructs
- Multiplex Automated Genome Editing (MAGE)

Tools

Molecular building blocks

- New expression control elements (cis + trans)
- Small molecule sensors
- Logic gates and devices
  - Tested in industrial strains & conditions @ DSM
- Orthogonal intra-/intercellular signaling
- New enzymes, scaffolding for co-localization
- New cellular compartments
- Refactored secretion systems
  - Used by Refactored Materials

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Tools

Test (HTP ‘omics)

- Metabolomics
- DNA / RNA sequencing
- Proteomics
- *In vivo* biosensors

Safety

- Reassigned genetic codes
  - *rE.coli* chassis
- Impact studies
  - GMO footprint in wastewater treatment facility

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Applications

Advanced Fermentation Organisms

- Cell density, metabolite concentration, toxicity-dependent responses, testing host-circuit interactions

Microbial Chemical Factories

- Successful demonstration of 3-HBL biosynthesis
- Refactoring nitrogen fixation & bacteriochlorophyll a

Mammalian

- Mammalian cell engineering tools
- Artificial morphogenesis

Yeast

- Upcoming, tools for yeast engineering

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