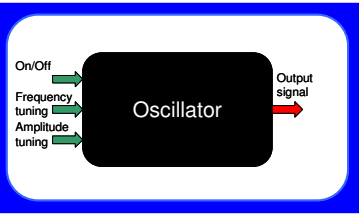
Imperial College London

Engineering a Molecular Predation Oscillator

Project Summary

- We have used the traditional engineering approach to build a stable and flexible molecular oscillator
- Our original design relies on population dynamics and was inspired by the Lotka-Volterra predation model
- Every step of the development cycle (Specifications, Design, Modelling, Implementation, Testing/Validation) has been fully documented on our OWW site

Specifications



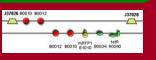
- Stable oscillations for more than 10 periods
- High Signal to Noise Ratio
- Controllable frequency and amplitude
- Modular design for easy connectivity
- Full documentation for quality control

Achievements

- Derivation of the complete dynamical model, describing the main biochemical reactions driving our oscillator.
- Full theoretical analysis and detailed computer simulations, validating our design with regard to our specifications.
- Successful building and characterization of functional parts, providing the building blocks for the final oscillator.

Our Favourite Parts

PoPs Blocker



- Use of Cre-Recombinase
- PoPs control mechanism defining an irreversible switch

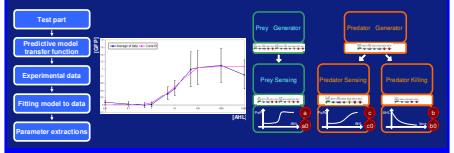
Prey Molecule Generator

- Production of AHL via positive feedback loop

Predator Sensing

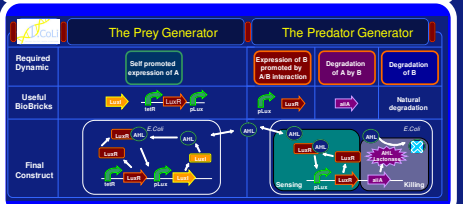
- Characterization of a new AHL sensing part

Testing/Validation



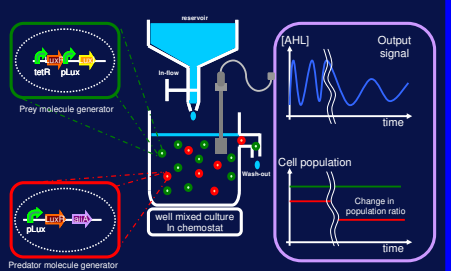
- Definition of testing protocols to satisfy component specifications
- Analysis of experimental data
- Characterization of the different test constructs for extracting parameters

Design

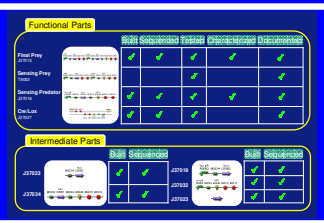


- Based on Lotka-Volterra predation dynamics
- Use of quorum sensing/quenching BioBricks available from the Registry
- Population wide oscillations of AHL in a chemostat
- Design broken down into two cell system to introduce higher flexibility

Our Full System Set-Up

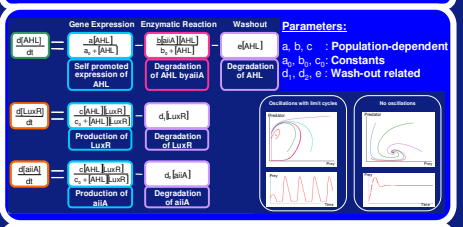


Implementation



- Standard assembly using BioBricks
- Successful building of oscillator components
- Contributions to the Registry by adding tested, functional and intermediate parts
- Quality control procedure

Modelling



- Derivation of the complete dynamical model
- Full theoretical analysis and detailed simulations
- Existence of oscillations with controllable frequency, amplitude and profile

http://openwetware.org/wiki/IGEM:IMPERIAL/2006

Team Members

Students

- Christin Sander
- Deepti Aswani
- Farah Vohra
- Jiongjun Bai
- John Sy
- John Chattaway
- Jonathan Wells
- Tom Hinson

Advisors

- Prof. Richard Kitney
- Prof. Paul Freemont
- Dr. David Mann
- Kirsten Jensen
- Vincent Rouilly
- Chueh-Loo Poh
- Matthieu Bultelle

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