iGEM 2014

WEEKLY NEWSLETTER

iGEM 2014
Weekly newsletter

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NEWSLETTER N°1

from July 28th to August 10th 2014

ETH ZÜRICH

OUR TEAM

ETH Zürich is taking part to iGEM since it was opened to the European universities (for the second edition).

The team has known several successes in the Information Processing track of the competition. This year, we are seven highly motivated students from different backgrounds, aiming to rock the Information Processing track once again. The interaction between wet lab and dry lab is crucial for our team.

OUR PROJECT

Make a Sierpinski triangle pattern appear in a grid
Conjugate quorum sensing and logic gates in bacterial colonies
Implement an XOR gate in an E. coli
Characterize integrases (retrieve missing parameters)
Study quorum sensing mechanism aiming to lower the leakiness
Be able to predict accurately the system's behavior

Questions it raises :
How can a complex pattern emerge from a simple logic rule?

What is to be considered as simple or complex?

How can leakiness, noise and lack of robustness in biological systems be handled?

Emergence of complex patterns in nature is a fascinating phenomenon, which is not fully understood yet. Some sea snail shells indeed present natural mosaics, made out of only two colors seemingly following a simple rule to form a pattern.

Our project Mosaicoli aims to implement a similar complex behavior. It challenges the high noise and the low robustness shown by biological systems. This cellular automaton consists of a regular grid of E. coli colonies. Either in an ON or OFF state, each colony interacts with its neighbours according to a fixed logic rule. Mosaicoli exploits quorum sensing, integrase logic gates and microfluidics to generate the Sierpinski triangle pattern. Communication between colonies is achieved by AHL molecules and subsequent updates in a cell state are determined by a discrete XOR integrase gate. The final state is read out via fluorescence, which collectively depicts a complex pattern. Mosaicoli deals with the leakiness of biological subunits to create a reliable complex entity, which can be considered as a first step towards the biological computer.

@ETH_iGEM
iGEM ETH Zürich
igem2014@bsse.ethz.com

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GOETTINGEN

OUR TEAM

University of Göttingen, Germany.

We come from different countries: Germany, China, Iran, Lebanon, India and Mexico. The group formed when the team of 2013 gave a presentation of their work and how they did in the Jamboree (they won the award for the best presentation in the overgrad division at the World Championship).

OUR PROJECT

Questions it raises :
Is it possible to select a short peptide with affinity towards fungal surface proteins out of a short peptide library?

We intend to develop a fast screening technique for different invasive fungi, such as Aspergillus fumigatus, Candida albicans and Aspergillus nidulans.

The idea is to tag the invasive fungal cells with a special protein marker that allows an easy detection of fungi. By modifying the protein marker with a proper signal molecule, we will be able to accomplish a fast and direct elimination of invasive fungi.

We want to prove the principle that it's possible to obtain short peptides with affinity towards a protein of interest through a high-throughput screening method. The proteins of interest in our project are fungal surface proteins, but they can be any other protein, such as tumor markers or other pathogenic microorganism surface proteins.

We also want to develop a diagnostic tool with those peptides. Here, our methodology is straightforward and it is mainly a proof-of-principle: we will tag a GFP marker and check for fluorescence. However, if this is successful, in the long term and after other sorts of chemical modifications, these peptides can be further applied as diagnostic and even therapeutic tools.

We are running for the Health and Medicine track.

igem2014@uni-goettingen.de

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GOTHENBURG

OUR TEAM

The Gothenburg team is currently working in the Systems and Synthetic Biology group, in the Department of Chemical and Biological Engineering at Chalmers.

Our team reflects the diversity of Chalmers and the iGEM competition; from the total of 10 team members, 5 of us are not Swedish, with different nationalities such as Brazilian and Indian. We are all students at Chalmers, mostly at undergraduate level, and with different backgrounds. Being the second Chalmers iGEM team is both challenging and rewarding. We are excited and inspired by the experience of the iGEM competition and having fun while learning!

OUR PROJECT

Our team goal with the iGEM project is to construct a yeast generation counter. The idea is that each time the cell divides a different florescent protein is produced. Therefore by examining the cell under a microscope or in a flow cytometer one can determine how many times the cell has divided.

Nowadays the determination of replicative age of yeast cells is done by counting the budding scars of each cell in a microscope, a process time consuming and not effective.

Our goal would be achieved by constructing a logical AND gate in the cell where the input signals consist of a cyclin activated dCas9-VP64 and a guide RNA (gRNA) signal from the previous cell cycle. The output response consist of a different fluorescent protein and a new gRNA molecule.

dCas9-VP64 is an engineered turntable transcription factor only active when dimerized with an interchangeable gRNA molecule. The gRNA also determines the specificity of the transcription factor which enables the dCas9-VP64 to activate different genes depending on the sequence of the gRNA molecule and the promoter. gRNA consists of two parts, a scaffold and a 20 bp Specificity Determinant Sequence (SDS) on the 5' end. The scaffold constitutes the majority of the gRNA molecule and gives it its structure whereas the SDS binds to the target site in the gene promoter. Cyclins are proteins that are involved in the progression of the cell cycle, therefore activated at specific times [5]. To mimic the specific production pattern of cyclins the dCas9-VP64 gene is placed under the control of a yeast cyclin promoter. Therefore the Cas9 will be produced in the G1 phase. When the Cas9 and gRNA dimerize and the transcription factor is activated, it in turn activates the transcription of a new fluorescent protein and a new gRNA molecule to act as a memory for the next cycle. Once this age counter is implemented, it would be possible to sort cells according to their replicative age automatically with a flow cytometer device.

pacheco@student.chalmers.se

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PARIS BETTENCOURT

OUR TEAM

Paris-Bettencourt iGEM team is part of the Center for Research and Interdisciplinarity (CRI) in Paris.

It was the first French iGEM team, and has long history of success in the competition. The team won the World Jamboree Grand Prize Award last year with the Fight Tuberculosis with Modern Weapons project. When deciding on a theme, above all else, we value creativity and the potential of our project to benefit society.

OUR PROJECT

Treating strong body odor using probiotics, producing a low cost perfume produced by bacteria and setting up a database of microbiome correlated to body odor

Questions it raises :
What kind of regulation would you like to see for GMO food/products? (Ex: mandatory labeling)

Would you buy a perfume that is produced by E. coli? If not, why?

What would you like to know about body odor? (Ex: does your body odor affect who is sexual attracted to you?)

This year, the Paris-Bettencourt team has decided to explore a topic that has rarely been approached by synthetic biologists in this competition: odor.

We are currently working on several projects related to odor:
Engineering bacteria to produce an odor library
Designing probiotics and cosmetic products aimed to help people with strong body odor.
Treating genetic diseases leading certain persons to have strong malodor.
Launching a citizen science project aiming to correlate armpit microbiome data with malodor

As for human practice, we are focusing this year on open-source biology and hope to get contribution from not only team members, but also the public, through collecting samples, crowdsourcing and updating of project development. At the same time, we are building a MOOC course for high school students. As popular as iGEM is above undergraduates and graduates, it is still quite new in high school. This course will include an introduction of Synthetic Biology, the social concern with it and work students through the important steps to form an iGEM team.
In addition to the scientific contribution to iGEM, we are aiming at improving scientific communication and opening the project to the general public. To facilitate open science the team is building an online collaborative platform to involve citizen scientists in the process. We believe, everyone has something to contribute to the development of science!

@iGEM_Paris
iGEM Paris Bettencourt
2014.igem.Parisbettencourt@gmail.com

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POLYTECHNIC UNIVERSITY OF VALENCIA

OUR TEAM

We are a team uniquely composed by students from the Polythecnic University of Valencia with the support of the Spanish National Research Council. In this iGEM edition we dare to work with plants and hope our work will encourage other teams to do so in the future.

OUR PROJECT

Avoiding damage in crops caused by pests, using pheromone-producing plants that disrupt insects mating and therefore avoid laying and damage caused by larvae.

Questions it raises :
In what fields do you think that using Genetically Modified Organisms (GMOs) could improve our lifestyle?
(Ex: Safer drugs production, bioremediation)

Would you accept using GMOs for non-eating purposes? If not, why not?

What do you want to know about crop protection against pests?
(Ex: How do insects behave in crops?)

This year, our team is developing an environmental friendly approach to control insect pests: The Sexy Plant.

The gist of the project we are working on is focused on the production of insect pheromones in the plant Nicotiana benthamiana. Our main efforts are aimed at avoiding the insect laying and the damage caused by insect larvae in crops. Since pests are one of the main causes of damage and the use of pesticides is getting more and more unpopular due to their environmental effects, our goal is to release the sufficient amount of pheromones into the air to cause mating disruption among insects, thus, male insects will not be able to find and mate with female insects, in the same way a soldier dressed in camouflage is difficult to be seen in a rainforest.

As for human practices, we are creating surveys about GMOs and Synthetic Biology in collaboration with other iGEM teams from different countries. This way, surveys from all the teams can reach a higher number of people with different regional culture, so the results are more global.

We know the importance of an early introduction in science. For that reason, we have carried out activities to increase kid's interest in science in our university summer school and we are creating a project to increase interest in iGEM for High School in collaboration with more iGEM teams.

@ValenciaUPViGEM
Valencia UPV iGEM 2014
valencia.upv.igem@gmail.com

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TJU-CHINA IGEM TEAM

OUR TEAM

Tianjin University IGEM team is one of the first entries to attend the IGEM competition in China. We started our IGEM journey from 2007 and we won a gold medal on our first try. Last year, our project AlkSensor won the gold medal and Best Poster award.
With the increasing times of successful or failed attempts in the competition. We have accumulated much meaningful experience in the field of synthetic biology. With all of the experiences and joint efforts, a more united, efficient and passionate team is built up.

This year we form a team of 16 students from the school of chemical engineering. Not only seeking help from our instructor, we are planning to launch a series of interchange activities with other teams and Chinese Academy of Sciences. We also pay attention to the potential impact of our project to our society. With our joint efforts, we hope, by exploring the relationship between science and life, we can make the world more wonderful.

OUR PROJECT

An efficient method to transduce biological sense into electric signal.

To detect the concentration of certain micromolecules quantitively in almost real time.

Questions it raises :
.If we set up this platform above, what aspects can it apply to?

2,What methods can be applied to real-time detection and analysis to some molecules that are difficult to detect in traditional ways?

3.How to maintain the stable structure of curli fiber when it functioned?

Biosensors are becoming more and more indispensable tools in life science, medicine, chemistry and biotechnology, which are greatly enhanced by synthetic biology.

Yet in the bio-sensing procedure, the limitations of signal output methods restrict the usage and practicality of biosensors. Wildly used reporters such as chromophore and fluorescent protein which requires laboratorial equipments to measure often result in the loss of accuracy and Immediacy.
Thus our project is focus on the bio-signal transformation to diversify output methods of biosensor. In account of the high maturity of silicon analysis, it will be a great advantage to transduce biological sense into electric signal.
Following this idea, we design a transducer which can convert the change of gene expression level that stimulated by inducer directly into the electric signal via inductive synthesis or destroy of nanowire between the electrodes. Curli fiber, a well characterized amyloid fiber which forms -sheet-rich amyloid fibers, seems to be an ideal foundation of our nanowire structure. CsgA, the modified morphon protein of curli fiber with the ability to bind nano gold particles, will play the role as the conductor.
Once we synthesize conductive curli fiber, there are two approach to carry out the target sensing, by inductively synthesizing the conductive fiber between the electrodes to turn on a switch for connecting a open circuit, or inductively expressing the gene coding the curli-degrading enzyme to destruct the pre-synthesized nanowire. The change of the electric current shall represent the concentration of inducer.

tjuigem2014@163.com

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UI-INDONESIA

OUR TEAM

We met for the first time in January 2014 and we're all undergraduate students from multidisciplinary backgrounds—medicine, biology, bioengineering, and also chemical engineering.

OUR PROJECT

Cholerae is major cause of death in children during first year of life in tropical country. Cholera is tropical neglected disease because it causes significant illness more than one billion people and cholera outbreak rises when the disaster comes, because of bad water sanitation.

In high cell density, Vibrio cholera formed biofilm to protect them from milieu exterior disturbance therefore antibiotic and other drugs treatment can not be effective against cholera infection. Here, we proposed a novel strategy to degrade cholera biofilm by using principles of synthetic biology. Our team genetically engineered E. coli to specifically detect quorum sensing (QS) molecule from Vibrio cholera. We use E.coli because it is normally found in human intestine. Mutagenic E.coli able to detect specific quorum sensing molecule by expressed receptor which is naturally expressed in transmembrane domain of Vibrio cholera, this receptor called CqsS receptor, a group of histidine kinases receptor. During biofilm formation Vibrio cholera will secret quorum sensing molecule called Vibrio cholera autoinducer 1 (CAI-1) which is bind to CqsS receptor in E.coli. CAI-1 molecule act as "find me signal" for E.coli, at the same time the binding of QS molecule to receptor in E.coli, it will active motile gene, CheZ which is enable E.coli migrate to source of infection, besides activate motile gene, it will also activate killing gene which is enable E.coli producing biofilm enzyme degrading matrix such as: alpha amylase, substilisin, and nuclease. After release enzyme degrading matrix our E.coli will secrete peptide 1018, an innate immunity peptide from human cathelicidin which is successfully expressed in E.coli as novel antibiotic peptide to kill Vibrio cholera directly. By interconnecting the principles of pathogen-directed motility with the dual system degrading and killing biofilm, we gained significantly develop killing activity to combat biofilm formation and further severe infection.

ui.igem2014@gmail.com

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USTC_CHINA IGEM TEAM

OUR TEAM

Our team, founded in 2007, joined the iGEM competition as one of the earliest teams in China and we got the 2nd runner up and fundamental advance project that year.

Nowadays, we still spare no time trying to make our project come true and propagate the biological knowledge to public.

OUR PROJECT

-Figure out the optimum conditions of C.Crescentus development, transformation and expression.
-Develop the holdfast in C.Crescentus.
-Extract the gene regulating the expression of holdfast in C.Crescentus and build parts with the regulating system
-Construct the light sensing-response system.
-Guide the accomplished system into E.coli and C.Crescentus.
-Pre-test the function and efficiency of ribozymes.
-Plan the industrialization and further development in biological imaging industry.
-Design the projector specialized for biological imaging

Questions it raises :
Do you wanna try photographic film produced by bacteria?

What do you care most when using this product?

How do you like the development of other fields' technology into biological system?

Will you believe the future when everything we use and require is produced by organism?

This year, our team attempt to combine the photographic film with biological system triggered by much careful investigation of bacteria imaging study and light inducible response both in recent research and iGEM team work.

We would like to call the system as Fast and Accurate Biological Chromatic Sensing-Imaging System(FABCSIS) by respectively joint red-green-blue (RGB) light sensing proteins with RGB florescent proteins into a new pedestal Caulobacter Crescentus, a kind of bacterium possessing adhesive holdfast which we can utilize for more stable expression in distinct surroundings like the water flow. And we are determinant to improve the system with ribozymes regulation to enhance the accuracy and speed of perception and response. At last, we will construct a customized projector to measure the efficiency of system and make a plan for the possibility of industrialization in the future. The FABCSIS, as we wish, will realize the chromatic imaging system firstly held in the media, regarding each individual as a pixel just like photographing. We believe our work will drive the further study and development of imaging system in other living organisms and one day biological photographic films will appear in everybody's daily life to change the world for its lowcost and high resolution

This year, we attempt to improve the technology in biological system and hope our job could influence the development and study of biological imaging chromatically. Besides, we seized many opportunities to introducing genetic engineering and synthetic biology to students who are intrigued in science, parents and people who are worried about GMO without any biological conception. We hope one day in China, everyone could make a decision scientifically with knowledge and judgement with our tiny efforts.

stark@mail.ustc.edu.cn