iGEM 2013 World Championship Jamboree

Program Information

Alberta

The Littlest Mapmaker

Track: Information Processing
Presentation: Room 10-250, Saturday 3:00 PM, Session 3
Poster: Session B, #19 (Stata)

Inspired by a 2007 iGEM joint project by Davidson College and Missouri Western State University, 'The Littlest Mapmaker' is the University of Alberta's effort to create a biological computer capable of solving the Travelling Salesman Problem, a logistical challenge in which a hypothetical salesman must find the shortest route through a series of destinations. Our travelling salesman computer is built from a combination of raw DNA chemistry and bacterial colonies: first it assembles the routes by stringing genes together, treating them like roads on the salesman's map, then the bacteria sort the good routes from the bad, identifying the answer through the quantity of bacterial colonies making use of each route. The most commonly used route is the winner!

AMU-Poznan

sh-miR designer - tool for construction of RNA interference reagents: sh-miRs

Track: Software
Presentation: Room 32-155, Saturday 3:30 PM, Session 3
Poster: Session A, #SW 6 (Stata)

sh-miR Designer will be a software aimed at fast and efficient design of effective RNA interference (RNAi) reagents - sh-miRs, also known as artificial miRNAs. sh-miRs are RNA particles whose structure is based on miRNA precursor pri-miRNA, but sequence interacting with transcript is changed depending on research purpose. Maintenance of structure of pri-miRNA is very important to enable cellular processing and therefore ensure functionality of artificial particles. sh-miRs delivered to cells on genetic vectors - plasmids or viral vectors - enter natural RNAi pathway and silence target mRNA. They can be used in genetic therapies and basic biomedical research.

Berkeley

Genes to Jeans: a green solution to blue denim

Track: Manufacturing
Presentation: Room 32-123, Sunday 1:30 PM, Session 7
Poster: Session B, #16 (Stata)

The world consumes over 40 million kilograms of indigo annually, primarily for dyeing denim. Indigo is currently derived from petroleum using a high energy process, and commercial dyeing involves the use of reducing agents to solubilize the dye. The development of biosynthetic and bioprocessing methodologies for indigo dyeing could have environmental and economic advantages. By combining the biosynthesis of indigo and the use of the natural indigo precursor indican, we propose a more sustainable dyeing method as an alternative to chemically-reduced indigo in the large scale production of indigo textiles. We achieved in vivo indigo production in high titers, and efficient cleavage of indican using a non-native glucosidase. Inspired by natural systems, we isolated and characterized several plant and bacterial glucosyl transferases hypothesized to produce indican. Lastly, we compare the cost and environmental impact of our alternative with the present chemical process.

BGU Israel

P.A.S.E. - Programmable Autonomous Self Elimination

Track: Environment
Presentation: Room 32-123, Sunday 9:30 AM, Session 5
Poster: Session A, #37 (Lobby 13)

Bioremediation and biosensors often require the release of genetically modified organisms (GMOs) to the environment. After being released, these GMOs are no longer under direct control. As their effect on the environment is unknown, they pose a potential threat. In order to eliminate this threat, we are developing a genetic circuit, using e. coli as a model GMO, that limits the lifetime of a bacterial population after it is released to the environment. Our goal is to allow the end user to program a GMO population to survive in the environment until it has completed its task, after which the entire population will disappear without any further external intervention. We employ two approaches to achieve this goal: One relies on the dilution of a synthetic control element through cell division, and the second is based on the lifetime of an essential protein containing an unnatural amino acid.

Bielefeld-Germany
Ecolectricity – currently available

Track: Food & Energy
Presentation: Room 10-250, Sunday 5:00 PM, Session 8
Poster: Session B, #1 (Stata)

There is a growing interest in the use of ecologically friendly alternative energy sources because of the depletion of fossil fuels and an increasing environmental pollution. Therefore, we are developing a Microbial Fuel Cell (MFC). The goal of this project is to generate electricity with a modified Escherichia coli in a self-constructed fuel cell. Besides the technical optimization of the fuel cell, we investigate different genetic approaches like integrating porines and cytochromes as well as endogenous mediators. Using heterologous expression of pore-forming transmembrane proteins, we are able to enhance the extracellular electron transfer, leading to higher membrane permeability. Direct electron transfer can be achieved by integrating cytochromes into the cellular membrane, whereas a production of endogenous mediators enhances the electron transport to the electrode. With different aspects for technical and genetic optimization we enable Ecolectricity, the use of E. coli for direct energy production.

BIT
A New Strategy to Detect Antibiotics in Milk: Based on Sensors with Controllable Bio-enhanced Blocks

Track: Food & Energy
Presentation: Room 10-250, Sunday 4:00 PM, Session 8
Poster: Session A, #13 (Stata)

Bio-amplification, especially controllable bio-amplification is significant for biological detection. In a synthetic biological way, 2013 BIT iGEM assembled the T7 RNA polymerase gene and T7 promoter as an amplification block (amplifier), which is based on the high activity of T7 promoter to amplify the signal. To make the magnification controllable, a lacO operator regulated by lacI was assembled in downstream as a control block (controller), by adjusting the concentration of IPTG. With this block, several sensors of materials including but not limited to antibiotics are able to be enhanced controllable. This year, a sensor of beta-lactam newly designed and one of tetracycline are applied to detect the residual of antibiotics in milk which endangers human health. To make the detection faster and more convenient, milk samples and engineered E.coli are mixed in a tailor-made bio-chip and the green fluorescence will be detected and shown on a tailor-made electronic equipment.

BIT-China
Intelligent Microbial Heat Regulating Engine

Track: New Application
Presentation: Room 10-250, Saturday 1:00 PM, Session 2
Poster: Session B, #25 (Lobby 13)

To keep the cells in a good condition, cooling system is used to control the temperature in fermentation process. However, the cooling system can result in a great consumption of energy, which increases the cost of production and causes resources wasting, global warming indirectly. To settle this problem, we constructed an Intelligent Microbial Heat Regulating Engine (I'MHeRE), which includes the customized thermo-tolerance system and the intelligent quorum regulating system, to help cells resist heat by regulating the expression of heat shock proteins and controlling the density of cells. The chassis host with I'MHeRE may make the fermentation less depend on the cooling system and shrink cost. Besides, cells could live well in higher temperature, because we extend their optimum living temperature and make them live in optimizing density. Owing to this, the activity of the enzymes in cells could be increased and the efficiency of microbial metabolism could be improved.

Braunschweig
Engineering synthetic microbial consortia

Track: New Application
Presentation: Room 34-101, Saturday 5:30 PM, Session 4
Poster: Session B, #12 (Stata)

Bacterial consortia offer a great benefit for synthetic biology due to the ability to perform complex tasks by splitting the whole reaction into smaller reactions and share the task among different specialized strains. Also, a self-regulating bacterial culture with intra consortial dependencies offers great advances in biosafety. To shut down the whole bacterial consortium, only on strain has to be eliminated. We engineer three different E. coli strains to grow in a consortium exploiting different Quorum Sensing systems. Each strain maintains a constitutive expression of an inactive transcription activator (LuxR, LasR or RhlR). Inducers are synthesized by different synthases (LuxI, LasI or RhlI) that are each expressed in one strain and subsequently secreted into the medium. Once taken up by a cell, the inducers bind to the corresponding, inactive transcription factors to render them functional. As a result, an antibiotic resistance under the control of an inducible promoter is expressed.

British Columbia
CRISPR MADE BY U – CRISPR Mediated Automated Design Employed to Bring You Ultrabiotics

Track: Food & Energy
Presentation: Room 10-250, Sunday 11:30 AM, Session 6
Poster: Session A, #27 (Lobby 13)

The past decade has seen the emergence of robust bioprocessing strains engineered to synthesize discrete molecular products. The next-generation of strains could be "programmable," with on demand generation of molecules within a bioreactor e.g. a yogurt fermentation capable of making any combination of flavouring, nutrients or pharmaceuticals. While merging all this potential into single hosts seems efficient, it would also bring added risk in the case of a process failure due to bacteriophage infection. Here, we not only rationally design widespread immunity to phage infection, but also hack this immunity system to yield programmable biosynthesis at the community level. We demonstrate this by building both broadly and specifically neutralizing CRISPR systems that were paired with biosynthetic capabilities for vanillin, caffeine and cinnamaldehyde production. Eventually, a fermentative process could exist that is vaccinated to phage infection but susceptible to targeted phage addition that results in a programmable probiotic – or ultrabiotic.

Buenos Aires
To drink or not to drink

Track: Environment
Presentation: Room 32-123, Sunday 4:30 PM, Session 8
Poster: Session B, #2 (Stata)

Our project is focused on developing a biosensor specific for certain water pollutants, with a modular and scalable approach. This approach would make it easy to adapt the response for the detection of different substances. In contrast to other iGEM biosensors, it does not rely on expensive equipment or qualified people to interpret the results. Being aware that most of the populations affected by consumption of contaminated groundwater don't have scientific or technical training, we intend the device to be cheap and easily distributed. We have designed it in a way that any user could easily determine the presence and level of the contaminant on drinking water, using image-based instructions. The project will focus on measuring a primary pollutant: arsenic. However, its modular and scalable design provides an easy way to measure various contaminants such as nitrate/nitrite among others.

BYU Provo
Phage Pharming: Two Approaches to Expanding the Use of Bacteriophage in Synthetic Biology

Track: Foundational Advance
Presentation: Room 34-101, Sunday 9:00 AM, Session 5
Poster: Session B, #34 (Lobby 13)

Bacteriophages are the most abundant organism on the planet, yet most are still uncharacterized. Current research is focused on finding new ways to use bacteriophage either in their wild-type state or after they have been modified for use in synthetic biology. We studied two ways to modify existing well-characterized bacteriophages. First, we employed random mutagenesis, CsCl purification, and plaque-size selection to isolate T4 and T7 bacteriophage with altered capsid sizes. A library of capsid sizes will allow researchers to select the appropriate bacteriophage for use in biotechnology or nanotechnology applications. Second, we designed a cholera sensing and destruction circuit using bacteriophage lambda. In this circuit, lambda contains biofilm-degrading enzymes controlled by a cholera quorum-sensing system transferred to E. coli. Upon sensing cholera, this E. coli will activate lambda, leading to cell lysis and biofilm degradation. This research demonstrates the versatility and utility of bacteriophages in the field of synthetic biology.

Calgary
The FerriTALE

Track: Food & Energy
Presentation: Room 32-123, Saturday 12:30 PM, Session 2
Poster: Session B, #28 (Lobby 13)

Outbreaks of foodborne illnesses are a growing problem for food safety and public health. Whether in your water, salad or steak, pathogenic E. coli causes upwards of 250,000 illnesses every year. To solve this problem, iGEM Calgary is developing the FerriTALE to detect harmful E. coli. It uses engineered proteins that detect and report the presence of dangerous E. coli in a sample. The detector, TALE, binds to genomic markers specific to dangerous E. coli. Next, our TALEs are attached to the scaffold and reporter, Ferritin, that rapidly alerts the user to the presence of E. coli through a visible color change. We have integrated these proteins into a handheld device, similar to a home pregnancy test, that tells the user if dangerous E. coli is present. Moving forward, the FerriTALE can be tailored to detect other pathogens as the basis of a powerful new detection platform.

Calgary Entrepreneurial
FREDsense: Building Better Biosensors

Track: Entrepreneurship
Presentation: Room 32-155, Sunday 11:00 AM, Session 6
Poster: Session B, #Ent 4 (Stata)

The development of petroleum-related industries around the world has lead to large amounts of environmental contamination. Alberta, Canada is faced with a specific challenge: the development of petroleum-related industries has led to large volumes of contaminated water, requiring extensive monitoring and remediation before the eventual release of this water back into the environment. Currently, methods of monitoring are either too slow, labour intensive, or inaccurately report on the toxicity of the sample. With increasing government regulation in the petroleum industry, the time for new technology is now. The 2013 Calgary Entrepreneurial team is advancing an electrochemical biosensor for petroleum-related toxins through our early venture: FREDsense. Using a unique sensing platform, our technology is faster, more quantitative, and capable of operating in environments where existing biosensors cannot. With collaborations in both industry and government, we are building better biosensors for the needs of the present, as well as the future.

Clemson
Development of a Universal Self-Amplified (USA) Biosensor for Repaid Detection of Viable Pathogens

Track: Environment
Presentation: Room 32-123, Sunday 3:30 PM, Session 8
Poster: Session A, #32 (Lobby 13)

Many regulatory agencies such as the Department of Agriculture and the Environmental Protection Agency have specific standards for pathogen concentrations in sample materials, including “zero-tolerance” for some foodborne pathogens. However, current detection methods for these disease-causing bacteria suffer from one or more of the following limitations: 1) requiring sample enrichment, 2) inability of low-level detection, 3) indiscrimination between viable and non-viable cells, 4) small sample volume capacity, 5) tedious procedures, and 6) high assay cost. Our Universal Self-Amplified (USA) Biosensor uses a genetically modified detection bacteria to solve many of the aforementioned issues. The engineered USA bacteria will recognize a target chemical produced by the pathogen of study, which will trigger a cascade of genes to both amplify the chemical signal and produce a visible alert to the pathogen’s presence. The USA pathogen detection mechanism strives for rapidity, economy, and simplicity.

Cornell
Organofoam: Genetically Engineering Fungal Mycelium for Biomaterials Development

Track: Manufacturing
Presentation: Room 10-250, Sunday 3:30 PM, Session 8
Poster: Session A, #35 (Lobby 13)

The goal of Organofoam is to develop a fundamental toolkit of genetic parts for engineering complex fungi, particularly plant-pathogenic basidiomycetes. We were inspired to do so by a local company, Ecovative Design, that uses lignin-degrading fungi and plant matter to produce a biodegradable Styrofoam substitute. The existing product that we are seeking to improve, known as “mushroom packaging,” is a sustainable and necessary alternative to Styrofoam. Polystyrene can take hundreds of years to degrade in landfills, produces dozens of identified chemical toxins upon combustion, and is tremendously inefficient to recycle, thus posing difficulties for disposal and polluting the environment. However, the production efficiency of Ecovative’s substitute suffers due to contamination from pathogenic molds, a problem that we seek to solve using synthetic biology. Using the complex, plant-pathogenic basidiomycete, Ganoderma lucidum, as a chassis, we are expanding the accessibility of fungal genetic engineering and demonstrating its utility for commercial purposes.

CU-Boulder
Cheap protein and DNA purification methods for DIY Bio

Track: New Application
Presentation: Room 34-101, Sunday 1:30 PM, Session 7
Poster: Session B, #9 (Stata)

The focus iGEM at CU-Boulder has been to make synthetic biology more accessible and affordable. We spent the summer developing parts, procedures, and documentation to help make this vision a reality. The original goal was to create the constructs and purification methods necessary to produce and isolate restriction enzymes. Along the way we explored some novel approaches to DNA and protein purification and developed experimentally tested protocols for these and other procedures essential to Biobrick assembly. Our purification methods exemplify the ideal of using common lab materials to make performing everyday lab techniques as accessible and inexpensive as possible. A related aspect of our project was exploring methods of recycling consumables associated with lab work in order to reduce waste and material expenses. We hope that our findings using this 'do-it-yourself' approach of synthetic biology help make this type of research more accessible for those where funding is limited.

Dundee
ToxiMop

Track: Environment
Presentation: Room 32-123, Sunday 10:00 AM, Session 5
Poster: Session A, #17 (Stata)

The ToxiMop project attempts to tackle the problem of freshwater algal blooms by detecting, reducing, and reporting the levels of the algal toxin microcystin. This toxin causes liver damage and is also speculated to be a carcinogen. Microcystin's toxic action lies in its ability to bind to the human Protein Phosphatase 1 (PP1), which is a major regulator of cell division, protein synthesis and other essential processes. Using synthetic biology techniques, we engineered bacterial chassis (E. coli and B. subtilis) to express PP1, which covalently binds to microcystin. The engineered bacteria can then be used as a molecular mop, the ToxiMop, to remove microcystin from contaminated water. Applying mathematical modelling to our experiments, we optimised our prototype ToxiMop. Additionally, we attempted to develop a biological detector for microcystin, which was combined with our electronic device, the Moptopus. This device has the potential for real-time monitoring and analysis of water bodies.

EPF Lausanne
Taxi.Coli: smart drug delivery

Track: New Application
Presentation: Room 34-101, Sunday 2:30 PM, Session 7
Poster: Session A, #10 (Stata)

EPF_Lausanne's team is proud to participate to iGEM 2013 and excited to present their project: Taxi.Coli: smart drug delivery. The team's vision is to build a biosynthetic drug delivery concept. The key word of this project is "adaptability". Our goal is to explore a way of using E.Coli as a highly modular carrier, opening the gate to several applications and alternatives in disease treatments. Using the principles of synthetic biology, we engineered a gelatinase secreting E. Coli able to bind gelatin nanoparticles using a biotin-streptavidin interaction and release them in a corresponding location. The drug delivery system is built in three parts: 1) the nanoparticle binding and 2) the environment sensing that 3) triggers the gelatinase release of the engineered E. Coli, liberating the content of the nanoparticle. The nanoparticles made of gelatin are able to carry any type of organic compound leading to a wide range of applications.

ETH Zurich
Colisweeper: The world's first biological Minesweeper game

Track: Information Processing
Presentation: Room 10-250, Saturday 3:30 PM, Session 3
Poster: Session B, #11 (Stata)

Colisweeper is an interactive, biological version of the Minesweeper computer game, based on luxI/luxR quorum sensing and chromogenic enzymatic reactions. The goal is to clear an agar "minefield" without detonating mines. Genetically engineered Escherichia coli colonies are used as sender-cells (mines) and receiver-cells (non-mines). Mines secrete the signaling molecule N-(3-oxohexanoyl)-l-homoserine lactone (OHHL) whereas non-mines process the signal. To distinguish between OHHL-levels, a library of PLuxR promoters with various sensitivities was created through site-saturation mutagenesis. High-pass filters were constructed to control the expression of different orthogonal hydrolases in non-mines, depending on the number of surrounding mines. Additionally, the mines express their own hydrolase. A spatiotemporal reaction-diffusion model was established to evaluate and improve the system. To play Colisweeper, a colorless substrate solution is pipetted onto a colony of choice. The result is a defined color change within minutes, allowing identification of the played colony and the number of mines surrounding it.

Evry
Iron coli Project

Track: Health & Medicine
Presentation: Room 10-250, Saturday 10:00 AM, Session 1
Poster: Session A, #25 (Lobby 13)

This year, our project focuses on diseases that are subsequent to an iron overload such as hemochromatosis and thalassemia. </p> Nowadays, iron overload is mainly treated by bloodlettings for hemochromatosic patients but this treatment cannot be extended to thalassemic patients who suffer from anaemia. The aim of our project is to prevent the intestinal absorption of iron by engineering Escherichia coli to produce siderophores, chelators of iron. This strategy acts directly at the source. </p> We engineer Escherichia coli using the Ferric Uptake Regulation (FUR) couple to an inverter system, in order to produce these siderophores in presence of iron. To reduce the patient's iron absorption, our bacteria is encapsulated in a pill. Once it arrives in the duodenum, our bacteria will produce the siderophore at their full potential and chelate the iron. </p>

Freiburg
uniCAS - The Toolkit for Gene Regulation

Track: Foundational Advance
Presentation: Room 32-123, Saturday 3:00 PM, Session 3
Poster: Session B, #14 (Stata)

Our Team developed a universal toolkit, termed uniCAS, that enables customizable gene regulation in mammalian cells. Therefore, we engineered the recently discovered and highly promising CRISPR/Cas9 system. The regulation is based on the RNA-guided Cas9 protein, which allows targeting of specific DNA sequences. Our toolkit comprises not only a standardized Cas9 protein, but also different effector domains for efficient gene activation or repression. We further engineered a modular RNA plasmid for easy implementation of RNA guide sequences. As an additional feature, we established an innovative screening method for assessing the functionality of our uniCAS fusion proteins. Single genes and even whole genetic networks can be modified using our uniCAS toolkit. We think that our toolbox of standardized parts of the CRISPR/Cas9 system offers broad application in research fields such as tissue engineering, stem cell reprogramming and fundamental research.

Fudan
ALeader: leading the advance of RNA synthetic biology

Track: Foundational Advance
Presentation: Room 32-123, Sunday 11:30 AM, Session 6
Poster: Session A, #20 (Stata)

RNA regulation patterns, which have not been fully understood so far, is a research hotspot still deserving exploiting. A recently-discovered riboswitch ALeader updated our ideas by its delicate, 75nt-structure consisting of an aptamer, a recombination site, and even a bicistron motif. Inspired by this natural design, we proposed a series of novel strategies this summer, with dynamic rather than static perspectives. Guided by the theoretical study on functional multistable states and semi-static states of a riboswitch, and the kinetics involving impacts from other systems such as CRISPR, RNA polymerases, ribosomes, and degradation complex, the ALeader-based functional multi-phase and tricistron switches are designed. We also tried to regulate aptamer's function by manipulating its working environment instead of itself, with SpinachALeader-based real-time monitors to avoid the signal distortion. Furthermore, to demonstrate the advantages of RNA biobricks, we constructed an antibiotic-detector with ALeader, optimized by a network with a RNA-OUT/IN translational regulatory system.

GeorgiaTech
Bacterial BioBots: Integrin-Based BioSensors

Track: Foundational Advance
Presentation: Room 10-250, Saturday 5:30 PM, Session 4
Poster: Session B, #24 (Lobby 13)

Our team goal is to develop novel bacterial BioBots that respond to the extracellular tissue environment. Mammalian cells communicate with the extracellular matrix (ECM) using heterodimeric cell surface receptors, called integrins, which can signal in a bidirectional manner between the cell interior and ECM. We aimed to express the integrin αIIbβ3 in E. coli cells. To promote dimerization of the integrin subunits, we attempted to optimize bimolecular fluorescence complementation of split GFP using surface display technologies. We cloned split GFP parts, assembling the T7-promoter, LacI-operator, and ribosomal binding site (RBS) upstream of the protein-coding region. To verify αIIbβ3 function, we developed an integrin activity sensor consisting of the ligand derived from fibrinogen (KQAGDV) coupled to GFP. Finally, we successfully created a new standard for RBS addition that inputs the strong RBS (BBa_B0034) in front of any standard BioBrick part, which is efficient and more successful than the usual 3A/standard assembly.

Goettingen
The beast and its Achilles heel: A novel target to fight multi-resistant bacteria

Track: Health & Medicine
Presentation: Room 34-101, Saturday 2:30 PM, Session 3
Poster: Session A, #11 (Stata)

Since the discovery of penicillin by Alexander Fleming in 1928, antibiotics have marked a major victory of mankind in the battle against infectious diseases. However, after 90 years, the antibiotics are now losing their old time glory: Bacteria acquire resistance against antibiotics and become unbridled. We must control the use of antibiotics, meanwhile, we need new antibiotics, which can suffiently eliminate the invaders without hurting the 'good' bacteria. Therefore, c-di-AMP, an important, recently discovered signaling molecule in gram-positive bacteria, has come to our sight. Our project is to build a screening system targeting c-di-AMP, which could be applied in novel-drug screening. With this system, the level of c-di-AMP in the cell can be visualised and measured.

Heidelberg
THE PHILOSOPHER'S STONE

Track: Foundational Advance
Presentation: Room 34-101, Saturday 11:00 AM, Session 1
Poster: Session B, #8 (Stata)

Several secondary metabolites, such as commonly used antibiotics, pigments and detoxifying enzymes, are synthesized by non-ribosomal peptide synthetases (NRPSs). These enzymes beautifully reflect one of the fundamental principles of synthetic biology, as they are remarkably modular. We will assemble new NRPSs by combining individual domains and modules of different origin, thus setting the basis for novel and customized synthesis of non-ribosomal peptides. To make the use of NRPSs amenable to a wider community, we will devise a new software-tool, called "NRPS Designer", which predicts the optimal modular composition of synthetic NRPSs for production of any desired peptide and outputs a cloning strategy based on Gibson assembly. As an application relevant to society, we will engineer Escherichia coli to recycle gold from electronic waste in a cost- and energy-efficient way through the heterologous expression of the NRPS pathway of Delftia acidovorans that naturally enables precipitation of gold ions from solution.

HokkaidoU Japan
"Maestro E. coli" ~optimization kit for expression~

Track: Foundational Advance
Presentation: Room 34-101, Sunday 9:30 AM, Session 5
Poster: Session A, #9 (Stata)

Thousands of genes are expressed in living cells. Their expression is cleverly controlled by promoters and RBSs. Precise regulation of recombinant genes is hard to achieve. Imbalance in regulation results in little production. However, it is hard to objectively select promoters and RBSs. We thought that E. coli could do the selection for us. We created a kit for E. coli to find the best suited promoters and RBSs. It enables our lab E. coli to be like "Maestro" who creates excellent harmonies with lots of instruments. For the kit we created an original promoter and RBS families with different strengths. We checked and made these parts to be reliable. And it only takes a single golden-gate assembly to get your construct! We made the promoters and RBSs by selecting from randomized libraries. Using the kit, E. coli can choose optimal promoters and RBSs by her/it/him-self, just like the maestro.

Hong Kong CUHK
Switch off PAHs

Track: New Application
Presentation: Room 10-250, Saturday 12:30 PM, Session 2
Poster: Session A, #23 (Lobby 13)

To rapidly regulate biological process, we designed a novel transmembrane protein called Voltage Switch (VS), which is a fusion protein utilizing the voltage sensing domain from potassium ion channels. Triggered by change in potential across the cell membrane, VS can separate or bring targeting enzymes into proximity, thus allowing an instant control of enzymatic reaction. We also utilized VS to accelerate the polycyclic aromatic hydrocarbons (PAHs) degradation system – another highlight of our project. The metabolites of certain PAHs are mutagenic and carcinogenic. We codon-optimized laccase from Bacillus sp. HR03 and catechol 1,2-dioxygenase from Pseudomonas putida KT2440 for Escherichia coli, which when forming a cascade, PAH degradation into less toxic simple carboxylic acid would occur. Since quinones are intermediates in the degradation of PAHs, we also added quinone sensing and response repressor (QsrR) to control the degradation process.

Hong Kong HKUST
FATBUSTER - The Artificial Futile Cycle

Track: Health & Medicine
Presentation: Room 10-250, Sunday 9:00 AM, Session 5
Poster: Session A, #21 (Stata)

While low-fat diet and regular exercise are popular approaches to fight with obesity, one easy alternative is simply to increase energy metabolism. In a synthetic biology approach, we are working to create an artificial futile cycle in mammalian cell by introducing glyoxylate enzymes native to bacteria. Past research has shown that mice expressing enzymes constituting an active glyoxylate shunt are shown to be resistant to diet-induced obesity. Our team plans to introduce an inducible system that allows us to couple the sensing of circulating fatty acid concentrations with an inducible circuit of glyoxylate shunt. Our inducible system is intended to prevent the risk of fatty acid deficiency, while facilitating greater fatty acid uptake at higher fatty acid circulating concentrations. Such a system should increase the feasibility of a glyoxylate cycle engineered to function in vivo.

HUST-China
Antihypertensive Ecoli

Track: Health & Medicine
Presentation: Room 10-250, Sunday 10:00 AM, Session 5
Poster: Session A, #33 (Lobby 13)

Hypertension causes grave concern worldwide for its notoriety, there're not many therapeutic methods to hypertension besides various antihypertensive drugs. However, this comes along with heavy financial burden to developing or underdeveloped countries. In addition, almost all these drugs have side effects to liver and renal. Here is a novel method to treat Hypertension by constructing human-friendly engineering bacteria that can produce short-chain fatty acids (SCFA) periodically and naturally to help maintain the blood pressure in safe level. SCFA, especially acetate and propionate, has been proved to induce vasodilatation and ensuing hypotensive response via receptors in smooth muscle cells of vessels. This year we have found a metabolic pathway in Escherichia coli that converts succinate to propionate through Wood-Werkman reaction. An operon consisting four genes encodes enzymes in this pathway. By combining bio-oscillator and key gene together, we want to make E. Coli release propionate periodically in patients' intestine periodically.

Imperial College
Plasticity: Engineering microbes to make environmentally friendly plastics from non-recyclable waste

Track: Manufacturing
Presentation: Room 32-123, Sunday 2:30 PM, Session 7
Poster: Session B, #33 (Lobby 13)

Accumulation of waste represents a considerable problem to humanity. Over the next 50 years, the global community will produce approximately 2 trillion tonnes of waste, or 2.5 times the weight of Mount Everest. Traditionally, mixed non-recyclable waste is sent to landfill or for incineration, both of which result in environmental damage. The detrimental effects are perpetrated by the plastic degradation into toxic byproducts and the production of greenhouse gases by these processes. As an alternative we propose to upcycle this mixed waste into the bioplastic poly-3-hydroxybutyrate (P3HB) to create a closed loop recycling system. Our engineered E. coli will operate within sealed bioreactors. In the future we picture the use of our system in a variety of contexts as part of our M.A.P.L.E. (Modular And Plastic Looping E.coli) system.

KU Leuven
E. coligy: Plants with BanAphids

Track: Environment
Presentation: Room 32-123, Sunday 5:00 PM, Session 8
Poster: Session B, #32 (Lobby 13)

Aphids, the little green plant-sucking bugs, can pose serious threats to a farmer's proceeds. Not only physical damage to the crops caused by the sucking is a problem, but aphids also transmit harmful viruses to the plants. The magnitude of loss is difficult to quantify as it changes with aphid species, crop species, location, year and other factors. The use of insecticides to control aphid population is contested, as it has a negative effect on the natural predators and aphids grow resistant. That's why we, the KU Leuven iGEM 2013 team, decided to do something about it in a sustainable way, using an insecticide-free controlling mechanism. With E.coligy: Plants with BanAphids we will teach E.coli cells to hack into insects signaling systems to drive off the aphids and attract the natural predators, such as the ladybug.

Lethbridge
Frame-Changer: Shifting Translation for Multiple Protein Expression

Track: Foundational Advance
Presentation: Room 10-250, Saturday 5:00 PM, Session 4
Poster: Session A, #12 (Stata)

The current growth in synthetic biology research promises more complex and useful engineered systems. However, increased complexity often requires more genetic material that can be difficult to introduce into organisms. We propose the development of a new library of regulatory gene expression elements that allow for compression of multiple coding sequences into a smaller amount of genetic space. Using a pseudoknot RNA structural motif, commonly used by viruses to minimize their genome size, we will show the utility of dual-coding gene sequences to give useful protein products whose expression can be regulated by the pseudoknot's ability to induce ribosomal frameshifting. A software tool will also be used to overlap multiple coding sequences into different reading frames. Ultimately, this library of standardized parts will be available for use in a variety of engineered systems requiring minimal coding space and multiple protein expression.

Lethbridge Entrepreneurs

Track: Entrepreneurship
Presentation: Room 32-155, Sunday 9:00 AM, Session 5
Poster: Session B, #Ent 3 (Stata)

Manchester
E. c(oil)i; The Lean, Green, Fat-Producing SynBio Machine

Track: Food & Energy
Presentation: Room 32-123, Saturday 12:00 PM, Session 2
Poster: Session B, #26 (Lobby 13)

From food products, to cosmetics and biodiesel, palm oil is the world's most widely used vegetable oil. Its demand is ever increasing; however the current method of extracting palm oil is severely unsustainable. Massive deforestation is required to build oil palm plantations, ruining the land of locals in Malaysia and Indonesia. Manchester iGEM aims to combat this by providing a more eco-friendly source of the four main components of palm oil. We reengineered the fatty acid biosynthesis pathway of E. coli to overproduce palmitic and stearic acid and introduced two new genes, Δ9 desaturase and Δ12 desaturase, to yield oleic and linoleic acid. To explore the scale-up potential of synthetic palm oil production in E. coli, we developed a fully parameterised kinetic model of the engineered fatty acid biosynthesis pathway.

Marburg
Phaectory: Antibodies grown with sunlight

Track: Health & Medicine
Presentation: Room 32-123, Saturday 5:30 PM, Session 4
Poster: Session B, #22 (Lobby 13)

The use of proteins in medical treatment and diagnosis is steadily increasing. Many pharmaceutically relevant proteins, such as antibodies, have a complex biological structure with specific posttranslational modifications. Furthermore, these proteins need to be highly pure because of their use in diagnostics and treatment. Therefore, a major challenge is the development of systems that produce pure, posttranslational modified proteins - best at low costs. Recently, the sunlight-driven microalgae Phaeodactylum tricornutum has been established as an elegant tool for the production of proteins. A major - however yet unchallenged - advantage of this system is the production of advanced proteins with specific posttranslational modifications and the ability of their direct secretion into the medium allowing easy purification with low effort and costs. Our mission is to challenge Phaectory for the convenient production of antibodies and make the system accessible to following iGEM teams.

Michigan
A Completely Unidirectional Biological Transistor Utilizing an Engineered Fim Switch

Track: Foundational Advance
Presentation: Room 32-123, Saturday 2:30 PM, Session 3
Poster: Session B, #20 (Stata)

Recent studies have just started to explore the possibility of utilizing existing recombination systems, to store information and perform computations. However, the only systems studied so far are not completely unidirectonal in their ability to flip a segment of DNA. Instead, previous systems have relied on "recombination directionality factors", which when complexed with the unidirectional recombinase, reverse the direction in which it flips the DNA segment. The fim system from E. coli, has been shown to contain 2 unidirectional recombinases, hbif and fime, which flip a promoter containing segment of DNA. Our project seeks to engineer the fim switch by replacing the native promoter with another promoter. We demonstrate that it can function as a reliable and efficient biological transistor, or "transcriptor". Beyond storing information and performing basic computations, the system would serve as a very useful, tightly controlled switch.

MIT
Engineered mammalian cell-cell communication mediated by synthetic exosomal cargoes.

Track: Health & Medicine
Presentation: Room 34-101, Sunday 12:00 PM, Session 6
Poster: Session A, #5 (Stata)

Coordinating behavior across cell populations to form synthetic tissues requires spacial communication between individual cells. While there has been some success engineering single signals, sending multiple signaling elements spanning spatial scales for multicellular coordination remains a significant hurdle. Here, we describe a method for mammalian cell-cell communication utilizing engineered exosomes containing miRNA or protein signals. First, we demonstrate selectively packaging signaling miRNAs (miR-451 and miR-503) and synthetic fusion proteins (GFP, Cas9, and Cre recombinase each individually fused to the oligomerizing membrane targeting domain Acyl-TyA) into exosomes within cells engineered with sender genetic circuits. Next, we demonstrate that these miRNA and protein signals can modulate gene expression within cells engineered with receiver genetic circuits. Finally, we present preliminary cell-cell signaling results on populations of cocultured sender and receiver cells. Our method may enable multiplexed communication among populations of various cell types and the creation of sophisticated synthetic tissues.

Nanjing-China
Atrazine Elf

Track: Environment
Presentation: Room 34-101, Saturday 12:00 PM, Session 2
Poster: Session A, #4 (Stata)

Atrazine, a widely used herbicide, persists for a long period in the environment onced used. It causes metabolic disorders in both animals and humankind. Our team utilized the ribosome switch induced by atrazine, a QS system of Plux and a degrading enzyme to control E.coil's motility through regulating it's CheZ gene. Therefore, E.coli can recognize atrazine, recruit team workers, and degrade atrazine. Our team found a transporter of atrazine, which we call TRM. We also mutated the degrading enzyme, TrzN, making it better at degradation. We combined TRM and the TrzN to improve atrazine absorbance and degradation. Moreover, our team are trying to analyze and compare several systems with computer, hoping to find the best one which is equipped with faster moving and quicker degrading. Overall, we believe our system will boost the industrialization, universalization as well as standardization in the field of treatment for atrazine and other versatile small molecules.

NCTU Formosa
E.colightuner

Track: Foundational Advance
Presentation: Room 10-250, Sunday 2:30 PM, Session 7
Poster: Session A, #6 (Stata)

We have proven a sRNA-regulated system of our own to be an effective and competent way for regulating gene expressions.</p> Recent studies have shown that sRNA-mediated regulation is an important factor to bacterial growth. sRNAs work by base pairing with limited or extended complementary target mRNAs, regulating protein productions. Using sRNA mechanism, we can control gene expression in RNA level, in contrast to common promoters that functions on DNA level. Since the existing sRNAs in Escherishia Coli have important functions in other metabolic processes, we designed an artificial sRNA with high specificity to avoid undesired base binding in vitro.</p> By using the sRNA-regulated system, red light induced operator, and thirty seven degree Celsius ribosome binding site (RBS), we constructed a manipulatable system that is capable of expressing four different genes under different conditions. In other words, it is a multitask machine.</p>

Newcastle
L-forms: Bacteria without a cell wall - a novel chassis for synthetic biology

Track: Foundational Advance
Presentation: Room 32-123, Saturday 3:30 PM, Session 3
Poster: Session B, #23 (Lobby 13)

L-forms are bacterial without cell walls that are still able to divide without the normally essential cell division machinery. The lack of a cell wall imparts a range of interesting properties and we show that L-forms can be used as a novel chassis for a range of fundamental applications in synthetic biology. We produced a BioBrick for Bacillus subtilis, that allows cell morphology to be toggled from normal to L-form. We have explored some of the interesting opportunities that L-forms provide including cell fusion, genome shuffling and the generation of differently shaped cells using microfluidics. L-forms are thought to exist naturally within plant tissues and we also studied their use as agents for delivering novel functionality into plants. For project outreach, we created a game as an Android application and considered the implications raised by our project and also look at the exciting relationship between synthetic biology and architecture.

NJU China
Biomissile: a novel drug delivery system with microvesicle

Track: Health & Medicine
Presentation: Room 34-101, Saturday 3:00 PM, Session 3
Poster: Session B, #31 (Lobby 13)

Recently, small interfering RNA (siRNA) has emerged as a promising therapeutic drug against a wide array of diseases. However, site-specific delivery has always been a challenge in gene therapy. Microvesicles (MVs) are lipid-bilayer vesicles which are naturally secreted by almost all cell types, playing crucial roles in intercellular transport of bioactive molecules. Given the intrinsic ability to naturally transport functional RNAs between cells, MVs potentially represent a novel and exciting drug carrier. In our project we are trying to express both anti-virus siRNA within the cell and target protein on the surface of the MVs by engineering the HEK 293T cell, which is capable of producing large amounts of MVs. Thus, the MVs produced by our engineered HEK 293T cells will contain the siRNA and be able to specifically deliver the siRNA to the sites we want, acting as biomissile for the targeted destruction of the disease.

NYMU-Taipei
Bee. coli: to bee, or not to bee

Track: Environment
Presentation: Room 34-101, Saturday 1:00 PM, Session 2
Poster: Session B, #15 (Stata)

To save bees from Nosema ceranae, the culprit of colony collapse disorder, we created Bee. coli. from E. coli K-12 MG1655, a bacterium residing natively in bees. Bee. coli is strategically designed to work as follows. First, it continuously secretes mannosidase to inhibit the sprouting of N. ceranae spores. Second, if the bee is infected, the fungus-killing-circuit with a positive feedback design will be turned on to wipe out N. ceranae. Third, if these designer weapons should fail to conquer N. ceranae, our designed bee-suicide-operon will be activated to kill the infected bee and save its companions. Fourth, a light-inducible lysis system is included to ensure our Bee. coli only lives inside of the bee. Fifth, we apply encapsulation as the way to send Bee. coli into the bee. Since the capsule will only dissolve in a bee's gut, our Bee. coli will not spread to the environment.

Paris Bettencourt
Fight Tuberculosis with Modern Weapons!

Track: Health & Medicine
Presentation: Room 10-250, Saturday 10:30 AM, Session 1
Poster: Session A, #1 (Stata)

We are testing new weapons for the global war against Mycobacterium tuberculosis (MTb), a pathogen that infects nearly 2 billion people. Our 4 synergistic projects aim to help in the prevention, diagnosis, and treatment of tuberculosis. 1) We are reproducing an essential MTb metabolic pathway in E. coli, where it can be easily and safely targeted in a drug screen. 2) We are building a phage-based biosensor to allow the rapid diagnosis specifically drug-resistant MTb strains. 3) We are constructing a mycobacteriophage to detect and counterselect drug-resistant Mtb in the environment. 4) We are programming E. coli to follow MTb into human macrophages and saturate it with bacteriolytic enzymes. We want to vanquish tuberculosis and build a TB-free world.

Peking
Aromatics Busted

Track: Environment
Presentation: Room 34-101, Saturday 12:30 PM, Session 2
Poster: Session B, #13 (Stata)

Aromatic pollution is becoming a worldwide concern, and monitoring aromatics remains challenging. Noting the abundant genomic data of prokaryotes from aromatics-rich environment, Peking iGEM applied part mining to the genetic repertoire to develop a comprehensive set of biosensors for aromatics. The transcriptional regulators for each typical class of aromatic compounds were bioinformatically determined and promoter engineering and protein engineering were performed to tune their function. To expand the detection range, enzymes in upper pathways, working as plug-ins, were coupled with biosensors to degrade aromatics to detectable compounds. For environmental detection, we construct the band pass filter to detect a certain range of concentration. Responses of biosensors equipped with band-pass filter can robustly reflect the concentration of environmental samples. Peking iGEM has remarkably enriched the library of biosensors for aromatics and enabled quantitative detection for environmental monitoring. These biosensors will be also potent for metabolic engineering and well-characterized synthetic biological tools.

Penn
Engineering the Epigenome

Track: Foundational Advance
Presentation: Room 34-101, Saturday 10:30 AM, Session 1
Poster: Session A, #30 (Lobby 13)

The code of life is more than a sequence of A's, C's, T's and G's; epigenetic modifications, such as DNA methylation, are powerful and heritable regulators of gene expression. Targeted methyltransferases are enzymes that catalyze sequence-specific methylation – the most useful tool for engineering the epigenome. With a synthetic biology approach, we developed an assay to test targeted methyltransferases without expensive, time-consuming traditional methods. Our modular single-plasmid system allows methyltransferases to be easily cloned and tested via inexpensive digestion assays, quickly measuring the existence and extent of targeted methylation. Additionally, our plasmid contains standardized primer-binding sites for methylation-sensitive sequencing, and our E. coli chassis effectively eliminated noise associated with methylation studies. We are using this assay to characterize our novel targeted methyltransferases, which could be used to study epigenetic modifications. In the future, synthetic biologists could embrace these tools to explore the next frontier in engineering biological systems: the epigenome.

Purdue
Back to the Basics

Track: Foundational Advance
Presentation: Room 10-250, Sunday 2:00 PM, Session 7
Poster: Session A, #8 (Stata)

Synthetic biology has striven to prove that classical engineering principles are applicable in the field of biology. Several challenges have yet to be overcome including design of robust genetic circuits, reliable gene expression, and a standard way to characterize parts. To assess circuit robustness, we utilized the power of the Taguchi Method, a statistical analysis which optimizes a set of parameters to form a robust system against outside noise while minimizing experimental time and cost. Making bicistronic expression operating units, which reduce the variability of gene expression, available in the Registry of Standard Biology Parts will enable efficient engineering of large networks. Finally, collaboration among teams allowed for a new standardized form of submitting characterization of parts to the Parts Registry. These three approaches to improve part standardization and robustness will help move the field of synthetic biology one step closer to proving that biology can, in fact, be engineered.

SDU-Denmark
Bacteriorganic Rubber

Track: Manufacturing
Presentation: Room 32-123, Sunday 2:00 PM, Session 7
Poster: Session A, #36 (Lobby 13)

The growing demand for natural rubber causes deforestation of the rainforest or occupation of arable lands, all due to the founding of new plantations. If producing rubber by bacteria succeeds, production of natural rubber will not be limited to the regions where the rubber tree can grow. Our project aims to make an E. coli strain able to produce natural rubber while grown under controlled conditions. Natural rubber is composed of polymerized IPP (isopentenyl pyrophoshate) units. E. coli already possesses the ability to produce IPP, but it lacks the polymerization enzyme, prenyltransferase, from the rubber tree. In this project we introduce prenyltransferase into E. coli and simultaneously manipulate the bacteria to produce more of the IPP links, consequently leading to the production of natural rubber in the bacterial setting.

Shenzhen BGIC 0101
Genovo

Track: Software
Presentation: Room 32-155, Saturday 1:00 PM, Session 2
Poster: Session A, #SW 7 (Stata)

Genovo is a Computer-Aided Design (CAD) tool used for denovo design of genome. The current version consists of 4 parts. The first, Chromosome Construction will grap genes in a common pathway and chromosome features to build a new genome and let user to define the order and orientation in drap-drop way. The second, Nucleotide Modification will optimize and soften the sequence of CDSs. It also help design the CRIPSR sites so that we can silence the wild type genes. The third, Chromosome Segmentation will cut chromosome into pieces and add 3A & Gibson & Goldengate & Homologous Recombination adaptors to the pieces automatically for assembly. The last one, OLS Design will guide users to gain the chromosome by microarray. Genovo will enable user to design their innovative chromosome as their wishes and further the research on genome on pathway level.

Shenzhen BGIC ATCG
Cell Magic

Track: Information Processing
Presentation: Room 10-250, Saturday 2:30 PM, Session 3
Poster: Session B, #29 (Lobby 13)

Cell Magic plays a gorgeous movie show in the both E.coli and S.cerevisiae.Various colors are blooming in different branchs & buds: plasma membrane, nucleus matrix, mitochondria membrane & matrix, vacuolar membrane, peroxisomal membrane, centrosome, and also actin. But the scene is far from static, colors will show up in order under the sophisticated cell cycle system at G1, S, G2 or M phase. Accelerator—degradation system is applied to run this movie faster, and freezer—sic1 system will put off the cell cycle during G1 phase. Beside, the editor—intron will expands a random dimension, leading to produce more combining form.

SJTU-BioX-Shanghai
Metabolic Gear Box

Track: New Application
Presentation: Room 32-123, Saturday 10:00 AM, Session 1
Poster: Session B, #3 (Stata)

Few researches have been done to regulate gene expression levels in genomic scale so far. This year we aim to combine two systems together in order to provide a universal and convenient tool which can be used to regulate different genomic genes simultaneously and independently in a quantitative way.

Our project involves the newly developed gene regulating tool CRISPRi and three light-controlled expression systems induced by red, green, and blue light respectively. Simply by changing the regulating parts in CRISPRi system towards mRFP, luciferase, and three enzymes, we hope to prove our system can be used qualitatively, quantitatively and practically step by step.

We have also designed a box and written a software as our experiment measurements. Simply by typing in several parameters, different gene expression levels can be controlled. This system can also be improved to predict the maximized producing efficiency after some simple tests in future.

Stanford-Brown
Synthetic Bio-Communication

Track: New Application
Presentation: Room 32-123, Saturday 10:30 AM, Session 1
Poster: Session B, #5 (Stata)

Communication is a dynamic requirement for life as we know it. We are using cellular and molecular messaging of different magnitudes to improve the broadcasting and reception of information. Starting on the atomic level, our BioWires project has created silver-incorporating DNA to act as nanowires, which could improve the cost and effectiveness of electronic products. Our CRISPR project is creating a system for DNA messages and resistances to be passed from cell to cell, in effect, creating transmissible probiotics and changing the way that cells communicate. We are also building a chromogenic biosensor to detect sucrose secretion that will be launched on a satellite (EuCROPIS) into low-Earth orbit. Finally, our De-Extinction project involves decoding messages from the past to better understand early life on Earth.

We are the Stanford-Brown iGEM team, and we're connecting life on Earth, to help us prepare for life beyond it.

SUSTC-Shenzhen-B
Circuit+

Track: Software
Presentation: Room 32-155, Saturday 10:30 AM, Session 1
Poster: Session A, #SW 1 (Stata)

To standardize genetic circuits and bring the idea that relations exist in circuit between parts back to synthetic biology, we proposed our Technical Standard RFC 101 and RFC 102 to define genetic circuits and logical gene gates. To solve the problem that synthetic biology lacks such a database to systematically record genetic circuits and to make the standards work, we built Circuit+, an online registry of standard genetic circuit which records information of circuits based on the two standards. Users can retrieve circuits, browse information, share by exporting SBOL and upload new circuits. We also have developed Clotho version Circuit+, Circuit List and transplanted TTEC to Clotho. And we have developed an online platform for synthetic biology lab management. We also did human practice to promote synthetic biology and iGEM.

SydneyUni Australia

Keeping DCA at Bay - Assembly of synthetic constructs and cassettes for degradation of dichloroethane.

Track: Environment
Presentation: Room 32-123, Sunday 9:00 AM, Session 5
Poster: Session A, #28 (Lobby 13)

The picturesque city of Sydney is marred by industrial efflux of chlorinated hydrocarbons into the aquifers around Botany Bay. 1,2-dichloroethane (DCA) is toxic and a suspected carcinogenic agent, and one of the more soluble and mobile contaminants. Conventional DCA treatment is both costly and time-consuming, involving pumping and heat-stripping groundwater. We propose a biological alternative which may be cheaper and more effective. There are strains of bacteria able to degrade low levels of organochlorine compounds in selective conditions. Polaromonas JS666 and Xanthobacter autotrophicus GJ10 contain two pathways of particular interest. Our goal is to construct our own versions of two metabolic pathways of DCA biodegradation for comparison in a BioBrick-compatible vector, and characterise their effectiveness in utilising DCA as a sole carbon source for growth. We hope to create friendly strains of bacteria capable of removing DCA at greatly reduced cost and effort, and reduce the environmental impact of industry.

SYSU-China

iPSC safeguarding Device

Track: Health & Medicine
Presentation: Room 10-250, Sunday 9:30 AM, Session 5
Poster: Session A, #26 (Lobby 13)

Since Shinya Yamanaka published the epoch-making paper in 2006, the induced pluripotent stem cells(iPSCs) has become one of the most promising techniques in regenerative medicine. Like embryonic stem cells(ESC), iPS Cells can be differentiated into any tissues. Compared with ESC, iPSC is easier to attain, immune rejection-free, and ethical issue-free. However, Further application of human induced pluripotent stem cells(hiPSCs) in tranlational medicine requires the concerns of two problems: the specificity of directional differentiation and the safety of the transplant. Here we design a new device which can spontaneously select hepatocytes from iPS differentiated cell mass and prevent potential carcinogenesis.To achieve accurate spatiotemporal control,we build a miRNA-122 sensor and make use of the tetracycline induction system.Our work may also be extended to the field of gene therapy, and provide a new direction to our train of thought about how to solve the safety problem in genetic manipulation of human cells.

SYSU-Software

CAST (Computer Aided Synbio Tool)- An Integrated Tool for Synthetic Biology

Track: Software
Presentation: Room 32-155, Saturday 12:30 PM, Session 2
Poster: Session A, #SW 2 (Stata)

Accurate simulation and gene circuit design are essential but difficult parts in synthetic biology.Here, we designed CAST to cover the workflow from beginning to end, users can focus on function design and the gene circuit would be automatically designed. Furthermore, we developed a new simulation model that work with standard dynamic characteristic and verified by wetlab experiments. Moreover, we build an expandable database that users can contribute their own dynamic information which would lead to more accurate and sufficient dynamic information of all the Biobricks. Finally, our software is designed as an easy deployed server so that it can be used on personal purpose or shared by a whole lab or institution.

TecMonterrey

Modular, synthetic biology approach for the development of a bacterial cancer therapy in Escherichia coli.

Track: Health & Medicine
Presentation: Room 34-101, Sunday 11:00 AM, Session 6
Poster: Session A, #3 (Stata)

By harnessing the inherent ability of facultative anaerobic bacteria to colonize and grow in tumoral environments, this project aims to prove the functionality of four different modules that would work together as a bacterial cancer therapy using Escherichia coli as chasis: Toxicity module, Secretion module, Localized induction module, and Internalization module. The expression of tumor specific therapeutic proteins, Apoptin and TRAIL, conforms the toxicity module. For these proteins to have their effect they need to be located in the extracellular matrix, therefore we are developing a module with a secretion function using hemolysin secretory mechanism. The hypoxic microenvironment present in tumors can be used for the localized induction module of tumor specific proteins, using the promoters HIP and nirB. Finally, Apoptin needs mechanisms to enter tumor cells' cytoplasm. Proteins with this requirement could reach the cytoplasm when coupled with the internalization module, resulting in a fusion with the TAT peptide.

Tianjin
Alk-Sensor, a Novel Detector Applied for the Selection of Alkane Producers

Track: Food & Energy
Presentation: Room 32-123, Saturday 1:00 PM, Session 2
Poster: Session A, #7 (Stata)

Biosynthesized alkanes are promising candidates for drop-in replacement of petroleum. We constructed and characterized a device named Alk-Sensor, which can sensitively detect a wide range of alkanes and generate certain response. Alk-Sensor is composed of ALKR protein——a transcriptional regulatory protein, and promoter alkM. ALKR recognizes alkanes and their interaction triggered a conformation change of ALKR dimers which isomerizes the promoter-RNAP complex and led to activate the downstream genes of PalkM. Based on Alk-Sensor, we built a relationship between productivity of alkanes with strain's growth rate under certain environmental stress. Starting from this relationship we further designed a novel selection method to select out the engineered strains with highest productivity of alkanes. We demonstrated that this novel selection method could enable us to select out the optimized strains effectively and efficiently.

Tokyo Tech
'Mutant Ninja. coli'

Track: Information Processing
Presentation: Room 34-101, Sunday 4:30 PM, Session 8
Poster: Session B, #18 (Stata)

In our project, we propose to create E. coli that mimic some of the qualities of Japan's ancient 'ninja' warrior-spies. A ninja must receive and pass on correct information at all times. A mistake will be fatal. We have created a circuit that avoids crosstalk between two signals in cell-to-cell communication, and we are also looking into applications for it. Ninjas are also known for their star-shaped 'shuriken' throwing knives. Our E. coli ninja has a similar weapon, an M13 phage which it releases to infect other E. coli, injecting plasmid DNA into them. Finally, ninja must harmonize with the natural environment, so their relationship to it is very important. Plant hormones help plants to grow efficiently, and we are attempting to construct a circuit that synthesizes two plant hormones depending on the soil environment.

Tsinghua
Mobile Health---Pathogen detector

Track: Health & Medicine
Presentation: Room 34-101, Sunday 11:30 AM, Session 6
Poster: Session B, #21 (Stata)

In a long term, the testing of pathogenic diseases is via comparably complex procedures. This year, we aim to design a sensing yeast powder based portable test paper, that is, the ' mobile' testing system, take advantage of querom sensing system in bacteria, to achieve the testing of specific microorganism caused disease. In the same time, we built a frame of testing any pathogen that will cause diseases, using different the input and output combination. Furthermore, in order to achieve the simultaneous testing of different pathogens, we design a "fast-shifting box" to accomplish the combination of input and output signaling. This will in theory

Tsinghua-A
Synthetic gene switch shows adaptation to DNA copy number variation

Track: Information Processing
Presentation: Room 34-101, Sunday 4:00 PM, Session 8
Poster: Session A, #29 (Lobby 13)

In some natural and synthetic biological networks, DNA copy number which transfection into cells is fluctuant，influencing gene expression. We hope target gene expression level has a strong adaptability and ability to DNA copy number by using the method of engineering and bringing in incoherent feed-forward circuit. The robust circuits we designed may apply to cancer detection and gene therapy in the future. Generally speaking, we modeled three and four nodes motifs to find some appropriate circuits, which function reliably in the face of fluctuating stoichiometry of their molecular components. Two designed circuits have been tested and we found that the motifs has certain robustness to DNA copy number.

TU-Delft

Peptidor: Detection and killing of resistant S. aureus using antimicrobial peptides

Track: Health & Medicine
Presentation: Room 10-250, Saturday 11:00 AM, Session 1
Poster: Session A, #19 (Stata)

Methicillin-Resistant Staphylococcus aureus causes major problems, especially in hospitals, leading to over half a million infections annually in the US alone. Of the alternative treatments currently under investigation one of the more promising is through antimicrobial peptides (AMPs). These small, highly-specific peptides attack the membrane of target organisms. Thousands of AMPs are known to exist and little resistance against them has been developed. The Peptidor project consists of an E. coli that can detect S. aureus, using S. aureus' native quorum sensing system, in order to locally produce and deliver AMPs. Upon detection, peptides inactivated by a SUMO-tag fusion, are overexpressed. After a delay period, introduced through a negative transcriptional cascade, a SUMO protease is expressed cleaving off the inactivating tag. Using this mechanism, high concentrations of peptide are delivered at the infection to efficiently kill S. aureus. As a safety mechanism, the timer also activates an E. coli kill-switch.

TU-Eindhoven
MRiGEM: Creating a production and delivery system for a CEST MRI contrast agent

Track: New Application
Presentation: Room 34-101, Saturday 4:30 PM, Session 4
Poster: Session A, #2 (Stata)

Our project presents an alternative solution to the use of heavy metals MRI contrast agents by focusing on CEST MRI. Within CEST imaging, proteins enclosing hydrogen atoms generate high quality images. We use Escherichia coli to create CEST proteins when the bacteria sense a hypoxic environment due to a promoter designed for this purpose, thus working as a production and delivery system for the CEST MRI contrast agent. Hypoxic regions are related to tumors, therefore our eventual goal is to use this device to target and image tumors in humans by injecting the bacteria into the bloodstream. A second application is tracking bacteria in bacterial infections studies. For the iGEM competition however, the proteins are only expressed ex-vivo: in aerobic and anaerobic conditions. We aim to achieve an efficient testing of the CEST properties of the proteins and confirm the promoter's ability to express each protein.

TU-Munich
PhyscoFilter – Clean different

Track: Environment
Presentation: Room 32-123, Sunday 4:00 PM, Session 8
Poster: Session A, #24 (Lobby 13)

The contamination of aquatic ecosystems with multiple anthropogenic pollutants has become a problem since the industrial revolution. Antibiotics, hormones and various noxious substances threaten environmental health and are not effectively removed by conventional waste water treatment. We propose to employ transgenic plants which produce effectors for enzymatic degradation (BioDegradation) or specific binding (BioAccumulation) of pollutants. The autotrophic, sedentary, aquatic nature of the moss Physcomitrella patens makes it an ideal chassis for a self-renewing, low-maintenance and cheap water filter. A light-triggered kill switch prevents unintended environmental spreading by limiting viability to places where the spectrum of sun light is appropriately filtered. Furthermore, we have developed a device to implement this biological filter in an aquatic environment, investigated the application of this new technology and examined its economic feasibility. Based on our results, PhyscoFilter may become a game-changing approach to improve global water quality in an affordable and sustainable fashion.

UANL Mty-Mexico
Integrating transcriptional and post-transcriptional regulation through the use of two synthetic RNA thermometers

Track: Information Processing
Presentation: Room 34-101, Sunday 3:30 PM, Session 8
Poster: Session B, #7 (Stata)

Temperature sensing RNA sequences, known as RNA thermometers, regulate translation by preventing the ribosome from binding the transcript until higher temperatures shift it to an open structure. Several naturally occurring RNA thermometers have been described, and synthetic sequences that emulate them have been designed and proved to regulate genetic expression at different temperature ranges. Here, we intend to build a genetic circuit that results in three discrete states whose transition can be regulated by temperature changes only. Most notably, our circuit integrates transcriptional and post-transcriptional regulation, widening the spectrum of potential genetic circuit topologies for synthetic biology, with applications that range from basic research to the replacement of chemical inducers for industrial-scale processes.

UC Davis
RiboTALe: A Tunable and Modular System for Control of Gene Expression

Track: Foundational Advance
Presentation: Room 34-101, Sunday 10:00 AM, Session 5
Poster: Session A, #14 (Stata)

Despite the fact that the Registry of Standard Biological Parts contains a large number of inducible promoters, the actual usage of these parts is dominated by a very select few. In order to increase the versatility of expression control systems, we propose a new system coupling transcription activator-like effectors (TALEs) with inducible riboswitches. TALEs are proteins secreted by the bacterial pathogen Xanthomonas that contain engineerable, sequence-specific DNA binding domains and can act as transcriptional repressors or activators. We plan to manipulate TALE activity by subjecting them to inducible expression through riboswitches and promoters. By pairing TALEs with riboswitches, we can expand the existing library of inducible repression systems. In addition, we hope to modify the parameters of our system to show the tunability and modularity of our overall construct. Through proper characterization, we believe that iGEM teams may also use these modular repression systems for the development of future devices.

UCL E
Darwin Toolbox

Track: Entrepreneurship
Presentation: Room 32-155, Sunday 10:00 AM, Session 5
Poster: Session B, #Ent 1 (Stata)

We are building a safe, user-friendly, affordable biotechnology laboratory in a beautiful 13 x 11 inch box, containing a centrifuge, a PCR machine and a gel electrophoresis unit inclusive with transilluminator. Our aim is to increase the reach of synthetic biology by providing the tools and infrastructure that will make biotechnology more accessible in educational settings and in citizen science. Darwin Toolbox connects effortlessly to a laptop or tablet computer to help keep track of experiment records and enabling them to be easily shared online with friends and collaborators.
Find out more about our vision of the future for synthetic biology and personal biotechnology tools: Join us for our presentation and more importantly, share your thoughts with us during the poster session.
What would you do with Darwin Toolbox?

UCSF
Operation CRISPR: Deploying precision guided tools to target unique species in a complex microbiome

Track: Foundational Advance
Presentation: Room 10-250, Sunday 1:30 PM, Session 7
Poster: Session B, #4 (Stata)

In microbial communities, bacterial populations are commonly controlled using indiscriminate, broad range antibiotics. There are few ways to target specific strains effectively without disrupting the entire microbiome and local environment. The goal of our project is to take advantage of a natural horizontal gene transfer mechanism in bacteria to precisely affect gene expression in selected strains. We combine bacterial conjugation with CRISPRi, an RNAi-like repression system developed from bacteria, to regulate gene expression in targeted strains within a complex microbial community. One possible application is to selectively repress pathogenic genes in a microbiome, leaving the community makeup unaffected. In addition, we use CRISPRi to lay the groundwork for transferring large circuits that enable complex functionality and decision-making in cells.

UESTC
Nebula

Track: Software
Presentation: Room 32-155, Saturday 12:00 PM, Session 2
Poster: Session A, #SW 4 (Stata)

Nebula is a biological circuit design tool composed of Interactive Part & Automatic Part. We classified the parts released in 2013 and constructed a database for users to choose what they want. In the first part, you are free to link any parts that we have already classified together to meet your requirement. In the second part, once you determine the inducer and the product, our software will offer you the optimized circuit with the input and output that you designated. We use Analytic Hierarchy Process to score every part and edges (passage linking two parts) according to attributions including availability, usefulness, sample status, part status and sequencing. According to weight of edges, we regard the shortest passage between input and output as the optimum presented to users. You can also save the circuits made in Nebula in case you want to check or change it later.

UFMG Brazil
CardBio (Cardiovascular disease biomarkers sensor)

Track: Health & Medicine
Presentation: Room 32-123, Saturday 4:30 PM, Session 4
Poster: Session B, #17 (Stata)

Death by heart diseases is very common worldwide, being Acute Coronary Syndrome (ACS) its main cause. This fact is deeply related to late diagnosis, which is usually made after the cardiac event had already occurred. We, from UFMG team, decided to explore this problem building a system capable of providing a precocious diagnosis for ACS based in 3 biomarkers: Brain Natriuretic Peptide (BNP), Trimethylamine-N-Oxide (TMAO) and Ischemia Modified Albumin (IMA). The main goal is to detect each of these biomarkers using our engineered E. coli by integrating the signals CFP, YFP and RFP produced when BNP, IMA and TMAO, respectively, are present in a sample of patient serum. This diagnosis is based on color intensity of the fluorescent proteins. So, we can establish the presence or absence and severity of ACS disease and predict earlier a myocardial event, thus providing information for fast treatment.

UIUC Entrepreneurs
Mission Statement

Track: Entrepreneurship
Presentation: Room 32-155, Sunday 9:30 AM, Session 5
Poster: Session B, #Ent 2 (Stata)

Vivosynth technologies seeks to further the application of manufacturing assembly line principles to the field of synthetic biology. Our flagship product, ModuLab, is an automated system designed to optimize every stage of the cloning process in order to minimize error, maximize efficiency and provide synthetic biologists with feedback on every stage of the manufacturing process.

UIUC Illinois
Cardiobiotics - A Genetically Engineered Approach to Cardiovascular Health

Track: Health & Medicine
Presentation: Room 32-123, Saturday 5:00 PM, Session 4
Poster: Session A, #15 (Stata)

Cardiovascular disease (CVD) has been the leading cause of death in the United States for over twenty years and is a rising global health issue. Recent studies demonstrate a correlation between CVD and atherosclerosis, the buildup of plaque in the arteries. One associated risk for atherosclerosis is the production of Trimethylamine N-oxide (TMAO) by natural gut flora when metabolizing L-carnitine, a chemical found primarily in red meat and energy drinks. We created a probiotic to attack the root of this problem by outcompeting the gut bacteria for L-carnitine in order to suppress the production of TMAO. L-carnitine transporters (caiX and cbcWV) and L-carnitine dehydrogenase (CDH) derived from Pseudomonas aeruginosa were expressed in a safe strain of E. coli (Nissle 1917). This engineered E. coli can uptake and metabolize L-carnitine along an alternative, safe pathway into 3-dehydrocarnitine. Together, this system offers a novel solution in preventing TMAO-related cardiovascular health conditions.

UNITN-Trento
B. fruity

Track: Food & Energy
Presentation: Room 10-250, Sunday 11:00 AM, Session 6
Poster: Session B, #27 (Lobby 13)

B. fruity envisions an environmentally friendly way to control fruit ripening by exploiting an engineered, light regulated strain of B. subtilis. The system works by synthesising ethylene or methyl salicylate (MeSA) upon photoinduction. Everything is housed in a vending machine-like enclosure that regulates fruit ripening in response to consumer demand. Ethylene is a natural plant hormone that is widely used to ripen fruit, such as bananas and kiwi. However, the synthesis, handling, and storage of ethylene is expensive and dangerous. In contrast, B. fruity produces ethylene from inexpensive material by exploiting a TCA cycle intermediate, 2-oxoglutarate, and the activity of P. syringae 2-oxoglutarate decarboxylase. The inhibition of fruit ripening results from the synthesis of MeSA via a pathway built with wintergreen parts. As a proof of concept, we engineered E. coli with the above systems plus the YF1/FixJ blue light receptor device.

uOttawa
Fold-change molecule detection using the Type-I Incoherent Feedforward Loop

Track: New Application
Presentation: Room 32-123, Saturday 11:00 AM, Session 1
Poster: Session B, #6 (Stata)

Many synthetic gene networks are susceptible to cellular noise, as they rely upon the absolute levels of gene regulators which can vary greatly between individual cells. To address this, uOttawa has engineered a network in S. cerevisiae that is responsive to fold-changes as opposed to absolute changes in stimulus. This allows the network to maintain sensitivity despite noise, and also permits response to stimuli in a much larger dynamic range. By modifying the promoter driving the stimulus, the network can be engineered to detect fold-changes of any molecule with a responsive promoter, thereby serving as a structural chassis for the next generation of molecule detectors. In addition, we have also authored a children's book aimed at disseminating the concepts of synthetic biology to the public, and have designed an online interface that will facilitate the rapid construction of devices built from the Registry of Standard Biological Parts.

Uppsala
LactoNutritious

Track: Food & Energy
Presentation: Room 10-250, Sunday 12:00 PM, Session 6
Poster: Session B, #35 (Lobby 13)

Malnutrition is today a major global problem that affects people both in affluent and developing countries. Even if you get the right amount of calories, if these do not contain sufficient amounts of micronutrients, like vitamins and minerals, serious illness and even death can be the result. The goal of our project is to alleviate this problem by applying synthetic biology to probiotic bacteria. With our project, we will make the lactobacillus genus the new probiotic platform for metabolic engineering of nutritional compounds. We will engineer probiotics to produce for example beta-carotene, resveratrol, p-coumaric acid, miraculin and saffron. To exemplify what this combination of probiotics and metabolic engineering can accomplish we used our modified bacteria to create nutritionally enriched yoghurt. We have also put great effort into addressing the ethical and safety issues that naturally follow when creating GM food.

USTC CHINA
T-VACCINE

Track: New Application
Presentation: Room 34-101, Saturday 5:00 PM, Session 4
Poster: Session A, #34 (Lobby 13)

T-VACCINE is a vaccine initiating immune response by penetrating the skin with the aid of transdermal peptide. From now on, injections are simply history.Based on the theory of user-friendly, a special group of engineering bacteria which produce T-VACCINE is used to create a brand-new 'band-aid' serving as a guardian of our health .We have found a kind of transdermal peptide TD-1,a magical molecule that enhances the permeability of the skin as well as draw filamentous bacteriophages into the skin.By combining the gene fragments of antigen,immune adjuvant LTB and Luman-recruiting factor TNLFα with that of the TD-1, our team got the permeable fusion protein. In order to obtain large amount of extracelluar protein, we chose bacillus subtilis WB800N as our expression chassis. Further more, the universality of our experimental method is verified by the adoption of various antigen of existing vaccine, such as HBsAg, PA and AG85B.

Valencia Biocampus
Wormboys

Track: New Application
Presentation: Room 10-250, Saturday 12:00 PM, Session 2
Poster: Session A, #18 (Stata)

Bacteria are essential in biotechnology, but they can hardly move. Nematodes, such a C. elegans, are fast crawling organisms, but they have limited biotechnological applications. By combining the best from both organisms, we present the first artificial synthetic symbiosis with bacteria engineered to ride on worms, which concentrate in hotspots where bacteria perform a desired biotechnological process, such as bioplastic (PHA) production. We have engineered Pseudomas putida with a whole operon that allows the formation of a biofilm on the worm. Biofilm formation is swhitched on and off depending on the media, and thus bacteria get on and off the worm like travellers on a bus. We have also engineered a third partner, E. coli, to express an interference RNA that promotes clumping. Taken together, our artificial symbiosis allows biotechnologically interesting bacteria to travel on nematodes, reach nutrient-rich biomass spots and maximize the efficiency of biotechnological fermentations in heterogenous substrates.

Virginia
Minicells: Multi-Purpose Nano Chassis

Track: Foundational Advance
Presentation: Room 34-101, Saturday 10:00 AM, Session 1
Poster: Session A, #22 (Lobby 13)

Overexpression of the tubulin-homolog FtsZ leads to asymmetric cell division in E. coli that yields achromosomal 'minicells.' The lack of a chromosome renders minicells unable to replicate and cause infection, yet they still retain and express plasmid genes. Furthermore, minicells inherit the stable, non-leaky membranes and cytosolic composition from their parent cell. Our project design is centered on the creation of an IPTG-inducible FtsZ Biobrick that permits tunable overexpression for optimal minicell production. With the development of a multi-purpose, innocuous bacterial chassis as our ultimate goal, we incorporated three additional safety elements: the Ail protein, a polysialic acid capsule and de-acylated lipopolysaccharide. Both Ail and the PSA capsule serve to prevent complement deposition on the surface of the minicells, with PSA also protecting against antibody opsonization. Finally, LPS toxicity is reduced by inducing minicell formation in an lpxM mutant strain that lacks a critical myristoyl transferase for late-stage acyl modifications.

Waterloo
Controlled Modification and Intercellular Transmission of a DNA Message

Track: Foundational Advance
Presentation: Room 10-250, Saturday 4:30 PM, Session 4
Poster: Session A, #31 (Lobby 13)

In nature, intercellular communication allows coordinated cellular behavior on a population level. Engineers seeking complex programmed population-level behavior require tools enabling controlled, information-rich intercellular messaging. Given its versatility and universality as an information-encoding molecule, DNA suggests itself as a message-carrying molecule to enable information-rich messaging. The Endy group at Stanford recently published a proof-of-principle demonstration of such DNA messaging wherein a DNA message was transmitted from one bacterial population to another carried by M13 bacteriophage particles. Here we propose an intercellular communication program that extends DNA messaging by controlling modification and transmission of a DNA message. Modification is controlled through flipping a DNA switch on the message DNA – a promoter sequence that is invertible using serine integrases and recombination directionality factors (RDFs). Transmission is controlled by placing expression of the M13 major coat protein, which is required for viral packaging of message DNA, under control of such a switch.

Wellesley Desyne
Enhancing Bio-Design with Next-Generation Human-Computer Interaction

Track: Software
Presentation: Room 32-155, Saturday 11:00 AM, Session 1
Poster: Session A, #SW 5 (Stata)

Systems that integrate the wide array of technological tools available to synthetic biologists are needed more than ever. As the field of synthetic biology continues to advance, it is critical to communicate the applications, goals, and limitations of synbio research to the public. Our team is creating a software suite, which addresses technical synbio challenges while improving end-user experience and harnessing human-computer interaction (HCI) to engage the public in synbio concepts. Eugenie is a visual language and integrated development environment for Eugene that allows biologists to specify biological parts, properties, and device composition rules. zTree is a tool for visually representing the Registry of Standard Biological Parts to support sense-making of complex, hierarchical data sets. Bac to the Future is a web-based, interactive application that utilizes Twitter to illustrate synbio ideas to the public. The application of HCI techniques to synbio fosters more effective, collaborative, and intuitive software tools.

WHU-China

Master of Regulation: dcas9-based Multi-stage Gene Expression Regulator

Track: New Application
Presentation: Room 32-123, Sunday 12:00 PM, Session 6
Poster: Session B, #30 (Lobby 13)

Cas9 is an RNA-guided dsDNA nuclease utilized by bacteria immune system. The genetically engineered Cas9 has recently been shown to have the ability to repress or activate desired gene expression. </p> In practical research and industrial application, we usually face the problem to express a gene at different levels, not only “on” or “off ”, so a more flexible regulation method is needed. To achieve multi-stage regulation of target genes, we further develop several dCas9 devices in which dCas9 alone or fused with omega subunit of RNAP is directed by various guide RNAs to different regions of designed double promoters. Therefore, promoters with disparate strength can be either activated or repressed respectively and multi-stage gene expression can be achieved. Also, based on such novel technology platform, we are developing diverse applications such as a guide RNA-mediated oscillator.

XMU software
Biobrick evaluation and optimization software suit and lab assistant tool

Track: Software
Presentation: Room 32-155, Saturday 2:30 PM, Session 3
Poster: Session A, #SW 3 (Stata)

The biobrick evaluation and optimization software tool suit (Brick Worker) provide analysis of biobrick sequences, namely, promoter, RBS, protein coding sequence and terminator. We use PWM algorithm to evaluate the relative strength of promoters and RBS and precisely locate the key region of the sequence that affect its performance. Through codon optimization and GA algorithm our program can analyze and then optimize the protein coding sequence so as to enhance the protein expression level. Terminator efficiency prediction is also included in this suit. As for the lab assistant tool (E’Note), it is a powerful experimental recording platform with exhilarating functions such as multi-line operating, software tool integration and template customization, providing a all-round as well as customized tool to significantly enhance the efficiency of experimental work.

XMU-China
A SynBio Oscillation Signal Converter

Track: Foundational Advance
Presentation: Room 32-123, Sunday 11:00 AM, Session 6
Poster: Session A, #16 (Stata)

Oscillations permeate every corner of the world, from the alternative current （AC） in power lines to our tiny microorganism friends. To use oscillations in bacteria as a strong and steady signal transmission method like AC, we need to tackle with the noise of transcription and translation in the cellular environment by coupling millions of cells through the synchronizing genetic oscillations in E.coli. At the colony level cells could be synchronized via quorum sensing, which is limited to tens of micrometers by the AHL, and between colonies a gas-phase redox (mainly H2O2) will serve as a signal that can give positive feedback to the whole circuit over millimeter scales simultaneously. On a liquid crystal display (LCD)-like microfluidic array bacteria grow in separate colonies, so that synchronization in both levels could be verified visually. Now a robust synthetic biology signal converter is accomplished and ready to show the growth environment of cells.

Yale
Converting E. coli into a foundry for bioplastics

Track: Manufacturing
Presentation: Room 10-250, Sunday 4:30 PM, Session 8
Poster: Session B, #10 (Stata)

Poly(lactic acid) (PLA) is a biodegradable, biocompatible, bioresorbable, thermoplastic bioplastic that offers many advantages over other biomaterials in both commercial and medical applications. The current chemical method of synthesizing PLA is expensive, and the required processing and purifying steps use many environmentally unfriendly chemicals. Recently, E. coli has been engineered to produce PLA, but low yields and short chain lengths prevent the approach’s commercial use. Here, we evaluate the potential of using multiplex automated genome engineering to raise both yields and chain lengths of biosynthesized PLA by directing the E. coli metabolism to funnel resources toward PLA production without sacrificing the organism’s viability. Efficient biosynthesis of PLA, which may be thus achieved, would be a significant step in reducing the impact of plastic waste, and would benefit those receiving bone implants. It would also open up a new possibility in rapid manufacturing of personalized bone implants using three-dimensional printers.

ZJU-China

A Tale of Aptamers: Ghost and Elf

Track: New Application
Presentation: Room 34-101, Sunday 2:00 PM, Session 7
Poster: Session B, #36 (Lobby 13)

This year we aim to utilize aptamer to specifically detect and clear molecules of different sizes. In order to detect and clear certain protein, we make tunneled E.coli called bacterial ghost that allow protein to diffuse in. We then build two types of inner-membrane protein scaffold, which will dimerize when pulled together by two aptamers attached to two sites of the protein. The dimerized proteins have enzymatic activity that can be detected via commercial test strips. The device will also sequester the proteins and allow us to clear them. In order to efficiently detect and clear a small molecule called atrazine, which is an herbicide causing tremendous environmental problems, we split our aptamer-based detection module and clear module into two strains. The first strain is chemotaxic to atrazine and will release quorum sensing molecules to attract the second strain, which contains atrazine hydrolase to clear it.