Better technique for probing RNA structure

Submitted by synbio on Fri, 12/16/2016 - 08:27

Probing RNA structure using high-throughput sequencing could revolutionize our understanding of the role of RNA secondary structure in regulation of gene expression.

The structure of RNA plays a key role in regulating its function and therefore gene expression; conventionally, novel structures are explored using chemical and enzymatic methods that interrupt RNA transcription. This can be combined with Next Generation Sequencing (NGS) to probe thousands of RNA molecules at a time. However, intrinsic noise and high sequence coverage requirements greatly limit the robustness of these techniques.

A team led by Sander Granneman and Guido Sanguinetti in SynthSys have brought together strengths in biology and artificial intelligence (specifically machine learning techniques) to create a modelling pipeline that can better account for natural variability and bias when exploring RNA structure. Ultimately that will create more accurate models and better understanding of structure-function relationships.

Using two yeast data sets, the team demonstrated that their method has increased sensitivity, and thus their pipeline identifies modified regions on more RNA molecules than existing strategies. The method also provides confident predictions at much lower sequence coverage levels than those recommended for reliable structural probing.

The team's results show that statistical modelling can extend the scope and potential of transcriptome-wide structure probing experiments.

The technique is published in *Nature Methods*.

Image: Full length hammerhead ribozyme, from Protein Data Bank ID 2GOZ CC BY-SA 3.0

Staff Public Engagement Award

Submitted by synbio on Fri, 12/09/2016 - 15:54

Congratulations to Dr Hannah Florance and Dr Gaynor Campbell, in the Centre for Mammalian Synthetic Biology, for their staff award for public engagment in the School of Biological Sciences.

The award was announced by Head of School, Prof David Gray, at a School meeting on Thursday 8th December.

Hannah and Gaynor received this award for their creativity and enthusiasm in explaining what synthetic biology is and what it can do for our planet through several outreach activities.

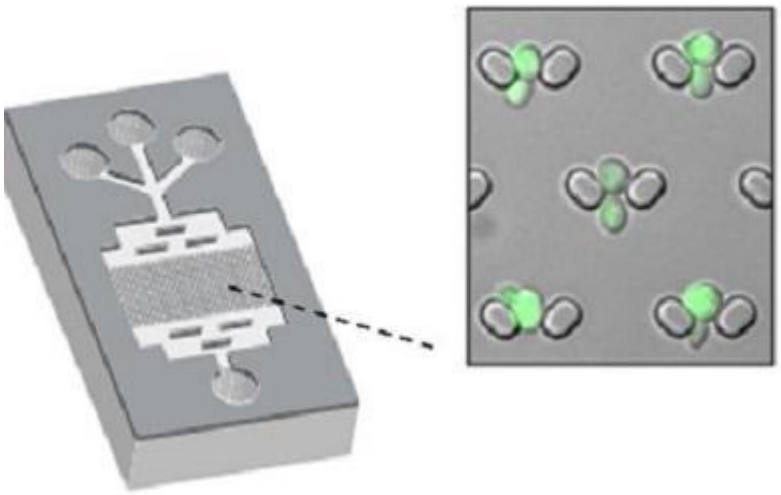
They helped to conceive the Master Biobuilder exhibit which has travelled around several science festivals reaching hundreds of children. The central character explains the concept behind building with DNA. It provides an opportunity for children (and grownups) to learn about engineering yeast and why we do it – how we'd go about constructing a metabolic pathway using cool fuzzy-felt bioparts - and then captures children's creative ideas about what they would build.

Hannah and Gaynor also participated in the Science Art Writing (or SAW) training course and took a unique and creative science project into local Edinburgh primary schools.

This reward is well deserved and Hannah and Gaynor are great role models for others interested in coming up with new ways to share the exciting and world-changing research that we do here.

Big promises from micro technologies – MicroTas2016 Report

Submitted by synbio on Thu, 11/24/2016 - 16:46



Microfluidics is moving mainstream and with such a wide variety of potential application is the perfect research tool for synthetic and systems biology. Dr Alex McVey, post doc in the lab of Dr Teuta Pilizota, attended the 20th MicroTas (Microscopic Total Analysis Systems) conference held in Dublin in October.

MicroTas is considered the largest conference on microfluidic devices and is run annually, hosted in Europe, USA and Asia on a three-yearly rotation. It includes a wide and varied programme incorporating all aspects of microfluidics including theoretical calculations of flow rates in differing structures, chemical reactions on the nanolitre scale, and scaled-up commercialised devices. MicroTas2016 covered the entire micro-scale (and pushed into the nano-scale) with channel sizes ranging from 10's of nanometres to 100's of micrometres. Of particular relevance to the synthetic and systems biology community are the talk and poster tracks relating to cell analysis, lab-on-a-chip devices and sensor and actuator detection methods.

A few of the more interesting and directly relevant topics, as well as some future directions, are highlighted below.

Jonathon Cooper of the University of Glasgow is using phonons to induce centrifugal force in blood cells. By positioning the droplet carefully he can cause it to spin, which if fast enough leads to lysis of the constituent parts of the blood.

Bongkot Ngamsom, part of Nicole Pamme's group at the University of Hull is using an integrated bioreactor on a microfluidic device in order to culture bacterial cells *in situ* before passing them to other parts of the microfluidic device for analysis.

The lab of Anja Boisen at Technical University of Denmark (DTU) has several interesting techniques including using an old CD turntable and a microfluidic device to separate liquids into constituent parts. The lab has shown this technique can be used to separate, amongst

other things, blood. They have also developed a method of measuring the amount of enzyme degradation during drug delivery by repurposing an AFM tip, which they attach enzyme to, and measure the change in resonant frequency as the drug is passed over the device. They then extended this method to work with liquids by using a hollow cantilever, allowing them to measure density and biomass as well as things like temperature. The group is running a summer school next year which might be of interest. http://www.nanotech.dtu.dk/Uddannelse/Sensing_Summerschool

Moonseong Park working with Ki-Hun Jeong in KAIST, Korea, has designed a method of optically mapping a single chromosome DNA by increasing the intensity of the signal using Surface-Enhanced Raman Scattering (SERS). A combination of SERS and a 30nm channel in a microfluidic device allows them to beat the diffraction limit and count very high concentrations of DNA.

The group of Abraham Lee at UCal Irvine, USA, have a method of extracting mRNA from a single cell using a microfluidic device. The device has a thin PDMS roof that can be pierced by nanotweezers (a modified AFM probe with 300nm pyramid tip) that allows them to select mRNA from a single cell.

Group of David Beebe at University of Wisconsin, USA, use microfluidic devices to co-culture two types of cell within the same device. The device is effectively two separate chambers on a single microfluidic chip and the conditions of each chamber can be optimised individually for both cancer and tissue cells. Once the cells have reached maturity, the chambers can be linked through microchannels, which has allowed them to show that signalling occurs between the two separate cell types.

Hang Lu from Georgia Tech, USA, has developed a very accurate way of patterning proteins on a surface using microfluidic devices and a stamping mechanism. This is done using two devices and covering a small area of the first before coating it with one protein type. The second device is then coated with a second protein type and then stamped onto the first device. The protein only attaches to the area of the first which has not been previously coated. The group claim that this technique produces a very well defined area of protein with at most a single layer of proteins interacting at the boundary between the two areas.

Yanxiang Deng and Aram Chung, Rensselaer Polytechnic Institute, USA, are investigating cell deformation by directing cells along a microfluidic channel and bouncing them off a wall.

The group of Dan Huh at University of Pennsylvania have created several lab-on-a-chip devices to replicate human organs. Among others they have lung, eye and gut models which have multiple layers (e.g. lung has both the blood vessel and the air sac, with ability of air and bacteria to diffuse between the two). Huh is also able to mechanically move parts of these devices (breathing lung, blinking eyelid) in order to more realistically recreate the tissue environment.

Sunghoon Kwon of Seoul National University, Korea, has shown that the use of microfluidics can dramatically speed up the time necessary for detecting antibiotic resistance by reducing the concentration of bacteria that need to be growing in an antibiotic concentration before identification can be made. They are doing this by taking the antibiotic susceptibility test away from plated cultures and putting it into microfluidics. They are then able to determine whether a bacterial culture is growing in a given concentration of antibiotic far quicker than waiting for colonies to be visible on a plate.

In summary

The microfluidics community has a lot to offer synthetic and systems biology researchers. The community is well established with many processes, such as rapid fluid control and switching; precise gradient control; cell sorting; trapping; and cell culturing in microfluidic devices routinely performed within the community. There was also an eagerness from many present in Dublin to engage further with biologists who may envisage a more practical use for many of the novel techniques the microfluidic community has developed.

In SynthSys, a handful of labs are already using microfluidics in their experiments but I believe that there is scope for far more labs to do so. With the Scottish Microelectronics Centre (SMC) on campus, and recently established facilities in the Roger Land and Waddington buildings, the University of Edinburgh has the capability of producing microfluidic chips and extending our capabilities. In the near future this should become even more accessible with the improvement of 3D printing techniques, making it feasible to 3D print large microfluidic devices (100s of micrometre widths), thus removing the need for clean-room training. MicroTas2016 reveals that the microfluidic community is eager and waiting for new collaborators with ideas for the application of their devices and methods.

If you are interested in pursuing the use of microfluidics for your research then please contact Alex for further information.

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Foundry establishes Executive Board

Submitted by synbio on Fri, 11/18/2016 - 15:26

The Edinburgh Genome Foundry specialises in the assembly of large DNA fragments, using a highly automated platform. The Foundry is funded by three awards totalling £5M from UK Research Councils' Synthetic Biology for Growth Programme, by over £1.5M refurbishment and technical support from the School of Biological Sciences and the University of Edinburgh, with further support from commercial partners Autodesk and ThermoFisher. At the formal opening of the Edinburgh Genome Foundry on 7 July 2016, the University recognised both these contributions and the ground-breaking work of the founding co-Directors (Doctor Patrick Cai and Professor Susan Rosser) and their team. The Foundry's management structure will now be revised, reflecting the Foundry's transition from the establishment phase to the operational phase. Dr. Cai and Prof. Rosser will join a new Executive Board, which will include senior university management to oversee the operational, financial and customer engagement activities of the Foundry. The Board will complement Dr. Cai and Prof. Rosser's supervision of the founding research awards and maintain scientific input, as the Foundry's operational processes and relationships to other stakeholders grow and develop in future.

Doctor Patrick (Yizhi) Cai, Chancellor's Fellow in Synthetic Biology in the School of Biological Sciences, said: "The Foundry's opening in Edinburgh realised a longstanding goal, to bring DNA assembly methods into the practice of modern biology. Our common aim is to ensure that many more researchers benefit from this combination of Engineering, Computer Science and Biology."

Professor Rosser, EPSRC Leadership Fellow and Chair of Synthetic Biology in the Schools of Engineering and of Biological Sciences, commented: "Building DNA on a large scale is transforming our delivery of current biological research and our vision for future understanding of how cells and organisms operate. The Board will help the Foundry's management to deliver this vision of high throughput DNA assembly to a wide academic and industrial constituency".

Professor David Gray, Head of the School of Biological Sciences, congratulated the co-Directors: "Doctor Cai and Professor Rosser established a team with the technical expertise, drive and dedication to create the Foundry's unique and highly automated platform, the first of its kind. We are grateful for the RCUK's support of our vision, which brings a major, new dimension to the School's world-leading research".

Professor Lesley Yellowlees, Vice Principal and Head of the University's College of Science and Engineering, said: "The University of Edinburgh is committed to support the most exciting and visionary scientific research and the researchers who deliver it. We are deeply grateful to Doctor Cai, Professor Rosser and their team for establishing the Edinburgh Genome Foundry and we look forward to celebrating its further successes in future".

Exploring Grand Challenges in China

Submitted by synbio on Tue, 11/08/2016 - 08:40

In early November, members of SynthSys headed to Shenzhen (China) to participate in the 11th International Genomes Conference and run a satellite workshop to explore the 'grand challenges' for our planet that could be addressed with synthetic biology.

The visit was just the first step in what will be a developing collaboration between China and Edinburgh to identify the most pressing challenges for south east Asia that might be realistically addressed using our combined expertise and resources in synthetic biology.

During the workshop, there were overviews of China's investment in synthetic biology, the excellent research ongoing on in key centres and some of the flagship projects from many of the lead figures in synthetic biology. The SynthSys team were very impressed with the quality of the synthetic biology ongoing in China and the substantial investment that has been made in both talent and infrastructure to support its future growth. The day-long workshop ended with a mapping exercise to highlight key challenges and opportunities, and much enthusiasm for working towards future collaboration.

Chinese research organisation, BGI-Research, kindly hosted the workshop in the newly opened Chinese National Gene Bank (CNGB), sited just outside Shenzhen. The CNGB was constructed by BGI-Research and funded by the Chinese Government as part of its 12th 5-year plan to support public welfare, innovation, science, research and industrial infrastructure. This architecturally stunning eco-building, will house two key platforms (DNA sequencing and DNA synthesis and editing) and three banks (a biorepository, a data centre and a living biobank). Something of a Chinese 'Noah's Ark,' the CNGB will store information relevant to personalised medicine, agriculture, the marine environment and microbes.

New Lecturer in Biotechnology

Submitted by synbio on Tue, 11/08/2016 - 08:00

The Centre welcomes Dr Stephen Wallace, recently appointed Lecturer in Biotechnology in the School of Biological Sciences.

Here he tells us more about himself and his research:

'I am originally from Thornhill in bonnie Dumfries and Galloway. I am an alumnus of the University of Edinburgh, where I graduated from the School of Chemistry (please don't judge me!) with a MChem. in 2008. I then pursued a DPhil. in organic chemistry at the University of Oxford, where my doctoral thesis was focussed on the total synthesis of a family of poison dart frog defence alkaloids. After this, I spent my postdoctoral years studying various aspects of chemical biology at the MRC Laboratory of Molecular Biology, Harvard University, MIT and the University of Cambridge.

As a result of my own training background, my lab here in Edinburgh is highly multidisciplinary, focussing on exploring opportunities at the interface of synthetic biology and synthetic chemistry. I have always believed that scientific advances occur when scientists think outside of traditional research paradigms. It is this belief that drives my lab's scientific curiosity and research trajectory. We are currently working on building designer microbial cells that can perform new whole-cell (bio-)transformations. I look forward to working with you all in the coming years!'

Stephen Wallace

'Rising Star in Science’

Submitted by synbio on Tue, 11/08/2016 - 07:00

Congratulations to Dr Patrick Cai, Chancellor’s Fellow and SynthSys PI, and founding co-director of the Edinburgh Genome Foundry, who was awarded the annual ‘Rising Star in Science’ award for his work on automation in DNA design and assembly and the synthetic yeast chromosome project. The award was presented during the Gala dinner at the 11th International Genomes Conference.

Second Report: Provision of Biological Data Management systems

Submitted by synbio on Thu, 11/03/2016 - 11:41

Practical evaluation of SEEK and OpenBIS for biological data management in SynthSys; second report.
http://hdl.handle.net/1842/15764

It was a knock out – the ultimate centre retreat?

Submitted by synbio on Tue, 10/04/2016 - 13:02

A bus load of 45 synthetic biologists headed to the beautiful Scottish Borders town of Peebles for the first retreat for the UK Centre for Mammalian Synthetic Biology (CMSB).

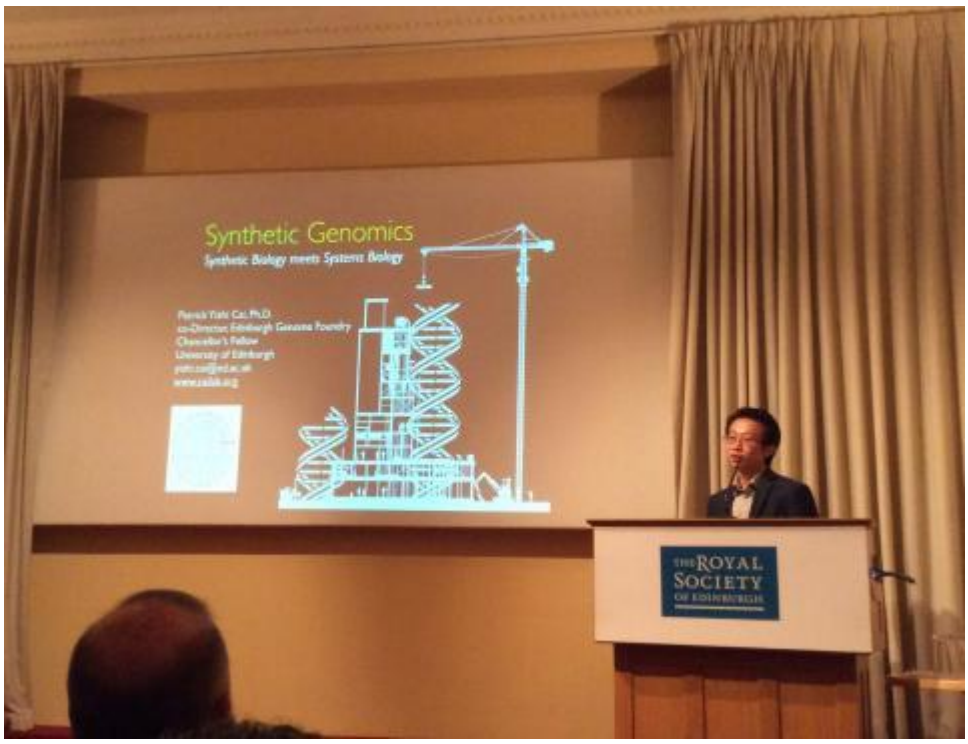
The team took a couple of days out of the lab to take stock on progress with the Centre's research programme and to better get to know one another. Joining us were our cohort of new PhD students, our partners in Social Sciences/Innogen, and several collaborators that have become part of the CMSB community since its inception.

Aside from the research talks, there were interactive sessions on our understanding of innovation and impact and a workshop for early career researchers on creativity and idea generation led by Alison Gray of Skillfluence.

But it wasn't all work: On Monday afternoon we braved the rain for a soggy session of that classic 'It's A Knock Out' game, which involved much more hilarity than dexterity, a range of incomprehensible wet inflatables, and a fair few sore bodies the next morning.

Acoustic genomics and the future of biology

Submitted by synbio on Tue, 10/04/2016 - 12:40



SynthSys hosted Labcyte's Annual Genomics Symposium at the Royal Society of Edinburgh on Sept 28 and 29. Over 80 delegates attended the event which featured an array of excellent talks from high-calibre international speakers exploring the role of liquid handling and automation in the disciplines of synthetic biology, drug discovery and single-cell genomics.

Dr Patrick Cai, SynthSys PI and Co-Director of the Edinburgh Genome Foundry, started the event with an overview of his lab's experience of constructing synthetic genomes using the Labcyte EchoR acoustic liquid handler in Edinburgh. There followed talks from the other UK Genome Foundries and a great perspective from Amyris, a leader in industrialisation of engineered strains.

Big savings in time, cost and researcher perspiration can be made deploying this state-of-art technology across a wide range of biological research areas. Whether for drug discovery or for single-cell analysis, the role of liquid handling, robotics and automation offers clear advantages for the future of academic and industrial research. This annual symposium offers a great opportunity to get a bird's eye view of what's happening at the coal face.

Open doors to synthetic biology

Submitted by synbio on Tue, 10/04/2016 - 12:15

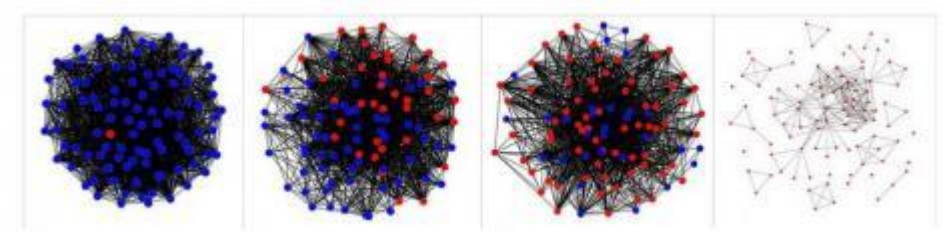
Over 70 visitors enjoyed learning about synthetic biology and its many applications at the Edinburgh Doors Open event in the Roger Land Building on Saturday 24th at the King's Buildings Campus.

Staff and postgraduate students from SynthSys, and this year's Edinburgh iGEM team, came along to explain more about their research and the power of synthetic biology. They were joined by staff from the Centre for Regenerative Medicine, who explained how stem cells are being used to create cells suited for therapy. Children had an opportunity to engineer their own fuzzy felt bugs, parents contemplated stem cells under a microscope and visitors were amazed at the metal munching power of microbes.

The Roger Land Building was constructed in the 1960s to house the Animal Research Organisation. The architect, Sir Basil Spence, is best known for his modern redesign of Coventry Cathedral, which was destroyed during the Second World War. The Roger Land Building has since housed the Institute for Stem Cell Research and has recently been renovated to house researchers from the School of Biological Sciences including the hub for the UK Centre for Mammalian Synthetic Biology.

Detecting the collapse of cooperation

Submitted by synbio on Thu, 09/22/2016 - 11:57



The sustainability of biological, social, economic and ecological communities is often determined by the outcome of social conflicts between cooperative and selfish individuals (aka 'cheaters'). Cheaters avoid the cost of contributing to the community and can occasionally spread in the population leading to the complete collapse of cooperation. The question was, can we foresee this problem arising.

A team lead by Dr Matteo Cavaliere of SynthSys and the School of Informatics, combined dynamical networks and evolutionary game theory to study the abrupt loss of cooperation with the tools used for studying critical transitions (e.g. these are used in ecology to address the issues of climate change). Although the collapse in cooperation can unfold unexpectedly, it was unclear whether it was possible to *detect* the risk of invasions of cheaters and the loss of cooperation in an evolving community.

The team observed an increase in the average time it takes for cheaters to be eliminated from the community as the risk of collapse increases. They argue that this slow system response resembles the slowing down of the recovery rates seen just before a critical transition. In addition, they showed how changes in community structure reflect the risk of the collapse of cooperation. The changes strongly depend on the mechanism that governs how cheaters evolve in the community. The results highlight novel directions for detecting abrupt transitions in evolving networks.

The work was published in Nature Scientific Report.

How bacteria cope with (osmotic) shock

Submitted by synbio on Tue, 09/20/2016 - 11:09

Research from the lab of Dr Teuta Pilizota has elucidated how bacteria manage to stay in control of their pressure and cell volume when placed in environments with low osmolarity. This insight could help better understand the behaviour of microbes in industrial biotech processing or when faced with antibiotic treatment.

Bacteria live and grow under significant osmotic pressure – the difference between osmolarity inside the cell and that of the environment. To help bacteria cope with shifts in osmotic pressure they rely heavily on mechanosensitive channels.

Teuta and her team used single-cell, high resolution imaging to monitor what happens when the common gut bacteria, *Escherichia coli*, is subject to a sudden decrease in external osmolarity (called a 'downshock'). Water floods into the cell, which would burst the cell if mechanosensitive channels were not forced open by the increase in tension in the membrane of the swollen cell. The channels then allow solutes and water to flow out, which stabilises the cell volume and prevents the cell from bursting. The process, while allowing control of cell volume and pressure, is passive. Once the channels open the control happens as a consequence of competition between solutes flowing inwards and water both outwards and inwards. For the first time, single-cell analysis of live cells showed that after a 'downshock,' a bacterial cell will first swell rapidly and then shrink back slowly to its original (and often smaller) size. This is a consequence of the passive nature of the process, it servers an emergency pressure release valve that as a consequence lacks tight control. However, the cells could continue to grow normally apparently unaffected by the insult.

Teuta and her team built and tested a model of this sequence of events using parameters associated with the flow of solutes and water across the cell membrane through the mechanosensitive channels. The model provided an accurate prediction of cell size changes.

Understanding how these systems are regulated is key to understanding how bacteria can survive in what can be harsh and hostile environments. Teuta is also collaborating with biologics manufacturing company, Fujifilm Diosynth Biotechnologies, who is interested in how microbes are influenced by the culture conditions and increased amount of protein product within industrial-sized bioreactors. Optimising the environment for industrial microbes could deliver substantial improvements in yield and productivity for many valuable products.

The research was published in PNAS

Transatlantic award to create eukaryotic cellular model

Submitted by synbio on Tue, 08/30/2016 - 16:58

Prof. Andrew Goryachev of SynthSys has received a Bilateral NSF-Bio/BBSRC award, which is specifically designed to fund bilateral collaborations between the UK and USA scientists. This award, which totals £1.5M, will be directed to support a major synthetic biology effort in both invertebrate and vertebrate eukaryotic cells. Andrew and his experimental collaborators at the Universities of Wisconsin-Madison, Michigan and Oregon will be working on creating Excitocell, a rewired eukaryotic cell model for the analysis and design of cellular morphogenesis. Last year, the four PIs leading the project and their colleagues published the discovery of excitable behavior in cellular cortices of oocytes and embryos in *Nature Cell Biology* (NCB **17**(11):1471-83). The new research will aim to control cortical pattern formation making use of synthetic proteins, *in vitro* reconstitution assays and novel optogenetic tools.

Synthsys PIs have been particularly successful in attracting funds from the NSF-Bio/BBSRC pilot scheme. The current award is the third in the series. Last year, two similar awards with the focus on systems biology were awarded to Prof. P. Swain and the team of Prof. K. Halliday and Dr. R. Grima.

Hands-On Research Summer School a Success

Submitted by synbio on Mon, 08/08/2016 - 08:55

Dr Teuta Pilizota and her post grad student Jerko Rosko took part in a two-week long summer school called Hands-On Research for Complex Systems in Trieste, Italy.

The School is designed to introduce graduate students and young faculty from developing countries to table-top scientific research on problems at the frontiers of science. Experiments on physical, chemical, and biological systems are conducted with modern yet inexpensive digital instrumentation, and the laboratory work is complemented by mathematical modeling and data analysis using Matlab.The Hands-On Schools foster the development of scientific leaders in less developed countries.

Each day for two weeks, small groups of 3-6 participants and two instructors work closely together on an experimental project, where the projects are rotated. In addition, the participants work with faculty on professional development skills (writing, poster presentations and flash talks). They then have the opportunity to apply the learning on their own poster and a flash talk, which are presented during the two weeks.

The School faculty are all eminent scientists who have conducted frontier table-top research published in leading international scientific journals such as *Nature*, *Science* and *Physical Review Letters*. While many areas of research now involve large numbers of collaborators using very expensive instrumentation, the Hands-on Research Schools focus on frontier research that can be conducted by individuals or small groups using rather modest instrumentation. Examples are taken from research of the faculty members.

Jerko and Teuta describe the experience as probably the most intense and rewarding teaching experience they have ever had.

You can find out more about the two week long summer school on the website (http://www.handsonresearch.org/).

Summer school participants enjoy some Italian sunshine.

Celebrating our Modern Apprentice's first year

Submitted by synbio on Thu, 08/04/2016 - 13:11

The UK Centre for Mammalian Synthetic Biology's first Modern Apprentice, Scott Neilson, is celebrating his first anniversary at Edinburgh. Here Scott and his manager, Eliane Salvo-Chirnside, reflect on the positive experience provided by this government-supported training scheme.

Modern Apprentice, Scott Neilson

I am Scott Neilson, one of the two Modern Apprentice (MA) lab technicians here at the Centre for Mammalian Synthetic Biology. I grew up with an interest in science and always felt my opportunity was missed when I decided not to pursue further education after high school. Luckily finding the MA programme has opened up the career prospects that I dreamed of as a child, while furthering my education.

The MA Lab Technician programme is run by Fife College. It opens up an alternative route into the science industry, allowing you to gain professional and academic qualifications while working in the lab. The course consists of one day a week of study at the science training school at St John's Hospital in Livingston and the rest of the week in the workplace. At the end I will be awarded an MA in Lab Techniques and Associated Practices,

a Professional Development Award and an HNC in Applied Science. The HNC course consists of chemistry, biology, statistics in science, health and safety, presentation skills and I.T. Once these units are completed, I will work on a project I have chosen myself which will determine my HNC grade. There are around 16 people on my course: three are Modern Apprentices at Scottish Water, and the rest work in various labs across the hospitals of Scotland and for NHS Lothian.

Over the past year I have been responsible for maintaining the lab of the Kinetic Parameter Facility and managing stock as well as assisting with ongoing research. Additionally I have been involved in several research projects with Dr Thierry Le Bihan, the Principal Director of our group and Technical Director for the Facility. This has helped me develop a number of invaluable skills such as experiment planning, data analysis, protocol optimisation and sample preparation. One of the main projects I was involved in was trying to optimise a new sample preparation method known as Gel-Aided Sample Preparation. I was tasked with extracting the necessary detail from the original paper and translating this into a working protocol. I was also lucky enough to receive some training on a new piece of automated machinery in the Edinburgh Genome Foundry, called the BioLector.

This opportunity has allowed me to see potential in myself that I never thought I had, which is opening up my prospects and showing me just how far I can go.

Eliane Salvo-Chirnside, Deputy Lab Manager and Scott's manager

There is growing gap in support labs of people suitably trained and motivated to carry out technical tasks from the sample preparation through to analysis. In the past, this gap has been filled with graduates wanting to develop practical qualifications to add their CV; but they quickly move on, which means much of the investment in training is lost. The Modern Apprenticeship offers a great solution: It is an alternative route for recruiting and training young people who have an interest in science but were not ready to continue with more traditional higher education routes for one reason or another. We can teach such skills and expose them to life in a research environment while they continue to get qualifications and remuneration. It's also refreshing to have young and enthusiastic junior lab members

In July 2015, the Centre joined the Modern Apprentice programme funded by Skills Development Scotland (SDS) and recruited Scott Neilson. Mentoring has been a very rewarding experience for me. I have watched Scott develop his skills in communication, numeracy and problem solving. The Apprenticeship has given him the opportunity to gain the confidence he needs to realize his innate talent and I've encouraged him to develop this even further. We are so impressed with the scheme and the quality of the Apprentices that we have just recruited a second.

Edinburgh on the map for DNA design and construction

Submitted by synbio on Thu, 07/28/2016 - 13:48

DNA design and assembly was the focus of three high-profile events in Edinburgh in early July. SynthSys launched its Edinburgh Genome Foundry, hosted the second SynBioBeta Activate! event, and held the 2016 Annual Meeting of the Sc2.0 International Synthetic Yeast Project.

This celebration of DNA started on July 7th with the formal opening of the first fully automated DNA production facility in the UK, the Edinburgh Genome Foundry (EGF). Funded by the UK Research Councils' *Synthetic Biology for Growth Programme*, with additional investment by the University of Edinburgh's School of Biological Sciences, the EGF will design, build and test large sections of DNA using highly automated robotic processes. Researchers at the facility are seeking to create and modify long strands of DNA that can be used to equip cells or organisms with new or improved functions. Its products could lead to advances such as programming stem cells for use in personalised medicines, developing bacteria that can detect disease in the gut, or altering the DNA of biofuel crops to enable a higher yield.

To celebrate the EGF opening, the University hosted its second SynBioBeta Activate! event in Scotland in partnership with Scottish Enterprise. This event attracted nearly 200 delegates and delivered a lively afternoon of discussion and debate on the role of automation and robotics in synthetic biology. There was a lineup of distinguished international speakers with an inspiring keynote from Ye Yin, CEO of BGI who talked about their ambitious plans in synthetic biology. Delegates then enjoyed short presentations from some of the leaders in

DNA design and assembly automation including Cambridge Consultants, Labcyte, Thermo Scientific, Pacific Biosciences, Autodesk, m2p Labs.

SynBioBeta founder, Dr John Cumbers, chaired a panel session including the leaders in gene synthesis – Gen 9, Twist Biosciences and Thermo – and asked 'how low can you go?' in the race to lower the price of DNA assembly. However, there was consensus rather than controversy with the panel agreeing that there was 'something for everyone' in the marketplace, and that no single assembly process will meet the needs of every synthetic biology project. The lowering of cost only serves to increase demand and to generate ever more creative opportunities enabled through large scale DNA construction.

Science fiction writer John Sundman (author of *Acts of the Apostles*) closed the event and provided food for thought with his personal reflections on the role of art and ethics in synthetic biology (you can read the transcript of his talk here). If synthetic biology can truly allow us to reinvent ourselves, are we ready for this? Does art have a role to play? Sundman believes it is essential if society is to derive benefit from this game-changing technology.

At the end of the event the Head of College of Science and Engineering, Professor Lesley Yellowlees, formally opened the EGF, before guests attended a BBQ on the rooftops of central Edinburgh in uncharacteristically clement weather.

The 5th Annual Sc2.0 and Synthetic Genomes Conferences was held on July 8th and 9th at Dynamic Earth hosted by Dr Patrick Cai, the international coordinator of Sc2.0 and also co-director of the EGF. The Sc2.0 project is currently the largest synthetic biology project in the public domain and is making rapid progress to complete construction of the entire yeast genome. With 160 delegates, from all corners of the globe, the meeting was an opportunity for collaborators to share success and discuss challenges. The agenda included some yeast-free sessions on topics as diverse as mammalian synthetic biology, the UK DNA foundries and the all-important social science aspects of synthetic biology. Some great networking went on as guests enjoyed great Scottish hospitality in the form of a craft beer tasting experience, and formal dinner and Ceilidh from local band.

For more information about the Foundry www.genomefoundry.org

Photo top: Dr Patrick Cai (co-drector EGF), Prof Lesley Yellowlees (Head of College), Dr Ceri-Lyn Adams (BBSRC) and Prof Susan Rosser (co-director EGF)

Fast or precise? Marine bacteria can be both

Submitted by synbio on Wed, 07/27/2016 - 15:33

When doing tasks we are often confronted with a fundamental question: shall I do it fast or do it precisely? From experience we know that achieving both is exceedingly difficult; compromise is the best bet. But can speed and precision be maximised at the same time? A new study from SynthSys PI Dr. Filippo Menolascina suggests that there is a way to do so and, even more interestingly, marine bacteria can teach us how.

While studying chemotaxis, the ability of microorganisms to seek nutrients in their environment and accumulate towards food 'hotspots', Filippo and his collaborators have discovered that a species of marine bacteria, *Vibrio alginolyticus* (a close relative of the bacterium that causes cholera), can dynamically alter its 'swimming style' to (a.) arrive at a nutrient source faster and, once there, (b) precisely identify the exact location and pack more tightly to the hotspot.

"The ocean is meager place," says Filippo says. "Feeding often means waiting for algae to burst or marine 'snow' to pass by: relatively rare events that often last only a few tens of seconds before the nutrients disperse away. Being able to exploit them makes the difference between life and death." The question is then how bacteria solved this problem. Filippo has found that there are two ingredients to success: (a) you need to get there before the others and (b) once there, you need to get the most out of it, i.e. you need to continuously track where the food hotspot is.

Swimming fast seems a good idea, but it will only help you get to the hotspot first. If you are very fast you can overshoot and effectively squander your advantage. Not a wise thing to do, also considered that speeding up is extremely expensive: increasing the swimming speed by a factor of two costs a cell four times as much energy.

Cells, at the microscale, are confronted with complex problems too: how can they make sure they arrive first, eat as much as they can and not waste energy in the process? Filippo has discovered that they increase their swimming speed only when they sense nutrients around them and, when they get to the nutrient source, they backtrack their steps more frequently, irrespectively of whether they are going up or down a gradient of nutrients. "They basically developed their own strategy to use a special combination of the cellular counterparts of gas pedal and handbrake/reverse gear." We can take inspiration from this strategy to build better engineered systems, from robots to synthetic cells, to effectively explore the environment.

Filippo used a combination of single-cell tracking of thousands of marine bacteria in microfluidic gradients and developed a new mathematical model of chemotaxis that explicitly accounts for swimming speed in the chemotaxis pathway.

His work provides closure on the long- standing question of why marine bacteria often swim so fast. In a resource-poor environment, speed not only helps them get there faster but they can retain 'pole position' for longer. This new understanding will help us better understand the ecological role of bacteria in important marine microbial processes such as the utilization of dissolved organic matter to the infection of coral reefs.

The research is published in PNAS USA 2016 Jul 20. pii: 201602307. [Epub ahead of print]

Flagship DNA facility sets sights on advances in science

Submitted by synbio on Fri, 07/08/2016 - 14:50

Scientists are marking the opening of the first fully automated DNA production facility in the UK. The Edinburgh Genome Foundry will design, build and test large sections of DNA – the building blocks of life – using large-scale robotic processes.

Researchers at the facility are seeking to create and modify long strands of DNA that can be used to equip cells or organisms with new or improved functions. Its products could lead to advances such as programming stem cells for use in personalised medicines, developing bacteria that can detect disease in the gut, or altering the DNA of biofuel crops to enable a higher yield.

Researchers at the Foundry, housed at the University of Edinburgh's School of Biological Sciences, will design and manufacture genetic material on an unprecedented scale. They will be able to design and build large, complex pieces of DNA code quickly at relatively low cost. The facility will support an international project to synthesis the entire genome of yeast, a model organism for research into living systems. An international team of researchers, led by scientists from Edinburgh, has already created the first chromosome of synthetic yeast.

The Foundry is primarily funded by the Research Councils UK's Synthetic Biology for Growth Programme.

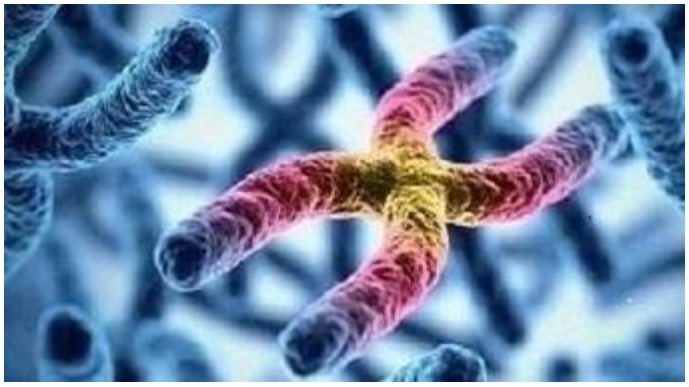
Science Minister Jo Johnson said: "The UK is home to the discovery of the DNA double-helix, a ground-breaking moment in modern science. An even greater understanding of DNA, and the ability to construct and modify it will lead to untold scientific discoveries that could save millions of lives around the world. "Through the investment by the Government, the Edinburgh Genome Foundry will ensure the UK leads the way in pioneering these new medicines."

Professor Susan Rosser, Co-Director of the Foundry, and Chair in Synthetic Biology at the University of Edinburgh, said: "We are excited to be opening the Edinburgh Genome Foundry, which will allow us to construct DNA on a large scale and will support synthetic biology in the UK. This will help us both interrogate how cells and organisms operate and realise the many economically important applications of synthetic biology."

Professor Patrick Cai, Co-Director of the Foundry, said: "The Edinburgh Genome Foundry, as the UK's largest integrated national facility for automated DNA synthesis assembly, will play a key role in ushering in major developments in the field."

The Human Genome Project Write - Comment

Submitted by synbio on Fri, 06/03/2016 - 09:53



Professor Susan Rosser and Dr Patrick Cai are authors on a letter published in *Science* outlining an ambitious international project to reconstruct the human genome - badged the Human Genome Project - Write (HGP-Write).

Professor Susan Rosser, Director of the UK Centre for Mammalian Synthetic Biology and Co-Director of the Edinburgh Genome Foundry, said: "The University of Edinburgh has a track record in this area of research through the work ongoing at the BBSRC/EPSRC and MRC funded Centre for Mammalian Synthetic Biology. Synthetic biology can greatly accelerate the study of the genetic basis of health and disease, research for which the University of Edinburgh has international leadership. We are keen to be a part of such an exciting international project, which would reflect our status in this field of research. Responsible research and innovation is core to this, and involves anticipation, reflection and engagement with relevant experts, stakeholders and the public."

The near-term applications for synthetic biology in humans are to further our understanding of the basic biology of human health and disease and for industrial applications, such as using synthetically modified human cell lines for drug screening or for more cost-effective production of medicines. The BBSRC-funded Edinburgh Genome Foundry - soon to be formally launched - has been at the forefront in genome design and the automation of genome assembly and will be a key player in providing technologies to enable the transition from reading genomes to writing genomes."

The Centre has an excellent track record in participating in what will be an international endeavour. Dr Patrick Cai, Co-Director or the Edinburgh Genome Foundry and a Cahncellor's Fellow at the University, coordinated the international synthetic yeast consortium (Sc2.0), which is the largest synthetic biology project today in the public domain. The Sc2.0 consortium is regarded as the gold standard for collaboration in synthetic biology, which is collaborative, inclusive, innovative and responsible.

Patrick adds: "If HGP-Write is going ahead, Sc2.0 will serve as a really good example to follow. There is little doubt the technology to synthesise human genome-scale DNA will be mature in the foreseeable future, and it is timely to start debating and planning for writing the human genome. We need to be very mindful about this powerful technology and should

not do the HGP-Write project only because we have the technology to do so. Greater freedom comes with greater responsibilities, and we need to think very carefully about the societal benefits, safety, IP and governance of this project."

If carefully chosen, some of the early pilot projects - which will focus on building small sections of the human genome (~1% of the total) of particular interest for medical research - will have clear, direct benefit to human health. We will have a much better understanding about the fundamental causes of some human disease and ultimately this leads to better treatments and improved quality of life.

Edinburgh is well positioned to take on some of these pilot projects. We are home to the UK Centre for Mammalian Synthetic Biology here, which focuses on applying synthetic biology approaches to improve human health. We have also established the Edinburgh Genome Foundry, the largest integrated facility for automated DNA assembly. We believe we will be a major player in the HGP-Write project.

You can read the paper here

http://science.sciencemag.org/content/early/2016/06/01/science.aaf6850

Prestigious award for Sir Adrian Bird

Submitted by synbio on Thu, 06/02/2016 - 12:28

Professor Sir Adrian Bird, a PI in the Centre for Mammalian Synthetic Biology and the Wellcome Trust Centre for Cell Biology, has been awarded The Shaw Prize in Life Science and Medicine 2016.

Along with Huda Y Zoghbi, Adrian discovered the genes and the encoded proteins that recognize one chemical modification of the DNA of chromosomes that influences gene control as the basis of the developmental disorder Rett syndrome. Genes are turned on and off in a precise order to achieve the intricate balance needed for human development. This process is orchestrated by the recognition of landmarks on chromosomes, including some chemical modifications of the DNA and of proteins that bind to DNA that suppress or activate gene function. Adrian Bird discovered that one such chemical change, the attachment of a methyl group to the C residue in DNA, serves to mark some genes to be turned off whereas the absence of that methyl group allows genes to be turned on. His research uncovered chromosome-binding proteins that recognize the methylC to switch off gene function. In the 1990s, Bird discovered five different proteins that have this binding activity, one of which, MEPC2, makes contact with an enzyme that removes an acetyl chemical tag from histones, a major chromosome structure-forming protein. These two tags, methylC in chromosomal DNA and the absence of acetyl groups on histones cooperate to reinforce an off signal on genes and contribute to the ‘epigenetic’ marking of genes. Working completely independently on a seemingly unrelated biological problem, Huda Zoghbi, a trained neurologist, made a surprising connection between one of Bird’s methylC binding proteins, MEPC2, and a challenging neurological disorder, Rett syndrome.

Synthetic biology goes back to school

Submitted by synbio on Tue, 05/17/2016 - 08:21

On March 8th 2016, Dr Meriem El Karoui had a great day with students at the James Gillespie High School in the City of Edinburgh discussing genetic engineering and synthetic biology.

Together with Maria Fanourgiaki (science communicator) and graduate student Rebecca Watson, Meriem delivered a workshop on genetic engineering originally designed by the Wellcome Trust Centre for Cell Biology. Maria and Becky explained the concepts of genetic engineering and how, for example, it can be used to manipulate pieces of DNA to make cells express useful products such as insulin. The students then used magnets to build plasmids and inserts making sure that they were pairing the bases (A,T,G,C) correctly. The students then had to combine plasmids and inserts to make synthetic constructs: each group had to partner with another group in their class that had the insert corresponding to the product they wanted to make.

After this hands-on activity, Meriem discussed how her lab uses synthetic biology to fight antibiotic resistance. She explained that everyone in the room had taken antibiotics at least once in their life and that these are only useful for treating infections caused by bacteria not viruses. The students then had a chance to ask questions about the research and how Meriem uses synthetic biology to block the spread of antibiotic resistance genes.

At the end, the students had to evaluate different genetic engineering/synthetic biology projects to decide which one they would choose to fund and why. It triggered a lot of debate and was really good fun!

The workshop was designed by Heather McQueen, Sarah Keer-Keer, Maria Fanourgiaki and Richie Cookson all of the School of Biological Sciences and Wellcome Trust Centre for Cell Biology.

If you would like more information please contact Maria (mfanourg@staffmail.ed.ac.uk)

Magnets are used to build plasmids (small pieces of DNA that can be easily inserted into cells) and inserts (that carry useful genes)

Wellcome Trust Centre for Cell Biology

£1.8M MRC award for improving iPSC technology

Submitted by synbio on Mon, 05/09/2016 - 09:33

Dr Abdenour Soufi, a Chancellor's Fellow, junior group leader at the MRC Centre for Regenerative Medicine (CRM) and a member of the UK Centre for Mammalian Synthetic Biology has received a prestigious Medical Research Council (MRC) Career Development Award (CDA).

The £1.8M was awarded to engineer novel synthetic factors to reprogram cell identity. Cellular reprogramming is a new technology that allows the conversion of human adult cells such as skin to any other specialised cells in the body. This has great potential in regenerative medicine as it will provide an unlimited source of functional cells to replace damaged or diseased tissue, bringing personalised cell-replacement therapies one step closer to reality.

Scientists can already reprogram biopsied human cells to become induced pluripotent stem cells (iPSCs) in the laboratory based on the discovery made by Takahashi and Yamanaka in 2006. These iPSCs are pluripotent, which means they can give rise to all cell types of the body.

Abdenour explains: “The current iPS technology uses genes called transcription factors (TFs) that are highly inefficient in reprogramming adult cells and have been associated with tumours. This makes the technology quite risky and unreliable to use in human patients.”

The funding is used to build a multi-disciplinary research group, which will bring together expertise from fundamental and translational stem cell research at CRM and synthetic biology at the UK Centre for Mammalian Synthetic Biology. Research will focus on engineering novel reprogramming factors. Firstly, the team of scientists will define which parts of natural TFs that are essential for reprogramming. These parts will then act as building blocks to design novel factors that are more potent in reprogramming.

In the news

Submitted by synbio on Thu, 05/05/2016 - 10:49

Dr Teuta Pilizota, a Chancellor's Fellow at the University and a member of the UK Centre for Mammalian Synthetic Biology, has been in the spotlight for her research on the biophysical properties of bacteria.

Teuta's collaborative research with bioproduction company Fujifilm Diosynth is featured in a new video produced by the BBSRC-funded NIBBS CBMNet (Crossing Biological Membranes Network) exploring the important work that the network does in catalyzing academic and industrial collaborations. You can take a look here.

The project started with a summer student funded by the CBMNet who looked at how changes in turgor in *E. coli*, generated by high sucrose concentrations, could help ease the harvesting of proteins from cells. This generated some interesting results that led to the award of a CBM Network Proof of Concept grant and a Business Innovation Voucher to further study the application of this strategy in a bioprocessing environment. It has also offered lots of valuable opportunities to gain additional insight in the real-world challenges faced by the bioproduction industry and how synthetic and systems approaches can provide solutions.

Teuta is a female physicist working on biology-related problems and passionate advocate for diversity in research and the importance of science and innovation. Recently she gave an interview to one of the two biggest daily newspapers in Croatia, her home country. Croatia is a recently joined EU member (2013) with small scientific output. In the article she spoke about her career in science and emphasized the importance of science and innovation to growing a country's economy. The interview was conducted by Tanja Rudez who was recently awarded a European Science Writer of the Year Award by the Association of British Science Writers.

Teaching excellence recognised

Submitted by synbio on Thu, 05/05/2016 - 09:43

Professor Jamie Davies, Professor of Exerimental Anatomy in the Centre for Integrative Physiology and a member of the UK Centre for Mammalian Synthetic Biology, has been awarded the 2015 Kendell Award for Teaching in Medicine 2016 at the University of Edinburgh. The EUSA's Teaching Awards recognise the teachers, support staff, courses, and learning communities that have an enormous positive impact on students' learning experiences at Edinburgh University.The student panel had chosen the awards in eight different categories amongst nearly 3000 nominations for this year. Jamie was also the recipient of this award in 2012 so this is a very well deserved 'double' achievement.

Wealth from waste innovation in awards line-up

Submitted by synbio on Wed, 05/04/2016 - 12:40

Dr Matt Edmundson, a postdoc working in the lab of Dr Louise Horsfall, has had his entrepreneurial spirit recognised in being one of the finalists for the Innovation Cup in Edinburgh's prestigious 2016 Inspire Launch Grow competition. He will pitch at a competition on the 9th of June, which is followed by an innovation exhibition and showcase awards ceremony.

Matt has developed a strain of bacteria that can convert toxic forms of arsenic into less harmful ones that can easily be separated out from a solution. This will be of great help in efforts to decontaminate both land and water on former industrial sites such as mines. He is also working on additional strains that can work on more valuable metal pollutants, and which can also convert them into useful materials called nanoparticles which can be sold, essentially turning waste into value.

The Innovation Cup is part of an annual business competition run by LAUNCH.ed, part of the University of Edinburgh's support system for entrepreneurship and business growth. The winner receives £5,000 cash towards their business.

Good luck to Matt!

You can follow Matt on Twitter @Dr_Eddy_1

The SAW Trust inspires with science-art workshop

Submitted by synbio on Thu, 04/21/2016 - 12:16

On April 20th, SynthSys hosted the SAW Trust to deliver a one-day training event for their innovative approach to teaching science to children using the power of words and pictures.

A group of 20 teachers, scientists, poets and artists went 'back to school' to learn the SAW Trust's innovative approach to teaching science with a view to applying this in schools over the coming months.

In what is the Trust's first training event north of the border, Jenni Rant (SAW lead and scientist) and colleagues Mike O'Driscoll (writer) and Chris Hann (poet) the workshop explained how a blended programme of fun hands-on science experiments coupled with imagery, poetry and art can convey in a meaningful way often complex science by harnessing a child's natural curiosity and creativity. The results speak for themselves (check out the SAW website for fantastic case studies).

There was very enthusiastic participation in themed activities during the day all around the topic of colour pigments including some 'kitchen' chromatography, DIY poetry, magic ice cubes and a flurry of paper, scissors, paint and crayons. It was all very therapeutic!

We often refer to 'the arts' and 'the sciences' as distinct yet there are probably many more similarities between their practice and practioners than we might realise: Creativity, exploration, research, experimentation, analysis, as a few examples, can apply equally well

to both. Together they can work together to bring colour and life to science and help children find their own way of exploring and understanding the world around them.

At the end of the workshop a team consisting of teacher, scientist, artist and writer got together to plan a themed workshop for five primary school classes in the Edinburgh region. In the future we hope to share best practice with others so we can reach even more children across Scotland.

The organisers would like to extent their thanks to James Howie of ASCUS for his help in making connections to local artists and writers that made the event such a success.

About the SAW Trust

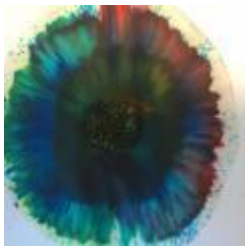
You can find out more about the SAW Trust at www.sawtrust.org and follow them on Twitter @SAWTrust The SAW Trust was founded by Anne Osbourn @AnneOsbourn1 a practising scientist and currently Associate Research Director and Institute Strategic Programme Leader, Plant and Microbial Metabolism at the John Innes Centre in Norwich. She has an international reputation for her work on plants and plant diseases. She is an ardent advocate of science and scientists engaging more fully with society. Her passion is inspiring children about science, and she is fascinated by the processes of creativity and exploration that underpin both scientific and artistic endeavour.

Feedback from the day

It's really exciting to be part of this excellent initiative and I really enjoyed our training day together.

It's lovely to learn from a range of disciplines/ professions and I very much look forward to trying a SAW project in school

Truly wonderful day yesterday - very inspirational and exciting.


Magic ice cube art


DIY chromatography


Getting creative now!

A fuzzy felt festival of science

Submitted by synbio on Thu, 04/14/2016 - 14:38

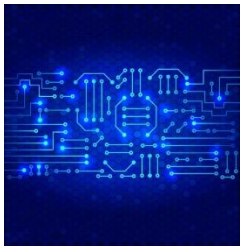
An enthusiastic gang of SynthSys researchers took synthetic biology to the Edinburgh Science Festival from March 31st to April 4th. Part of the School of Biological Science's 'Biodiscoveries' activities, the Centre sought to explain the fundamentals of synthetic biology to the primary school age visitors and their carers and to showcase some of the exciting research projects underway in Edinburgh.

The Centre's artist in residence, Mrs Alia Pietsch, helped bring to life our Master BioBuilder who explained in simple terms what synthetic biology is and what we can use it for to benefit the planet. Our visitors then got to sniff and guess their way around the synthetic yeast chromosome project. There was an opportunity for children to follow instructions to build their own fuzzy felt plasmids (promoters and terminators included) to create useful bugs, and also postcards to capture the children's ideas of what they would build (including yeast that makes chocolate)! if they were Master Bio-Builders.

There were 2,900 visitors over the 5 days and our exhibit was one of the favourites . We are looking forward to more opportunities to have our Master BioBuilder explain the wonders of synthetic biology.

International collaboration to expedite rational design in synbio

Submitted by synbio on Wed, 04/13/2016 - 09:21



Dr Filippo Menolascina, Chancellor's Fellow in Institute for Bioengineering (School of Engineering) and a member of SynthSys, has been awarded with a Royal Society-MoST (the Taiwanese Ministry of Science and Technology) grant to work with Prof. Torbjörn Nordling's group at National Cheng Kung University, Tainan City, Taiwan on the *in-vivo* automatic model inference for synthetic gene circuits.

Mathematical models are enabling a 'silent revolution' in the life sciences that is driving research and innovation faster than ever before. Unfortunately, generating these models remains an exceedingly laborious and expensive activity. First, there is the theoretical challenge of identifying the right (chemical) stimuli to interrogate cells, the equivalent of 'asking the right question.' Next there is the practical challenge of generating these stimuli (especially problematic for large scale reactors, e.g. multiwell plates and when the timing of stimuli can vary) and then refining the model while the experiment is running to decide on the 'next best question' on the fly.

Filippo and Torbjörn are going to address this head-on combining principles from control theory and system identification with *in-vivo* experiments. They plan to develop an automated platform for imaging of live cells by integrating video microscopy and microfluidics in closed loop system. Central to this platform is the image acquisition and real-time processing algorithms which will allow the groups to infer and update, fully automatically, mathematical models of gene circuits with the shortest possible experiments. Allowing to save time and money, this project will help 'democratize' the process of obtaining mathematical models in synthetic biology. The team hopes that reducing the cost at which mathematical models can be generated will eventual broaden their use, for example in the process of understanding why a given circuit does not work and which interventions (e.g. new promoters, ribosome binding sites, degradations tags) are needed to make it work.

The project, which will last two years, will give the the team a chance to change the way synthetic gene networks are built. The rational (re)design of synthetic circuits is a key stepping stone in relieving some of the disadvantages of one of the fundamental bottlenecks of synthetic biology: the 'trial-and-error' approach. By automating the inference of synthetic circuits models, the team will be able to optimise this practice, guiding the exploration of circuit design space. The ultimate goal is ambitious: to fully unlock the power of rational engineering in synthetic biology.

Leadership Award

Submitted by synbio on Tue, 04/12/2016 - 16:47

Dr Filippo Menolascina, a Chancellor's Fellow in Biosystems Modeling and Control in the Institute for BioEngineering at the University of Edinburgh has won a place in the 2016 cohort of the prestigious Scottish Crucible, run by the Royal Society of Edinburgh. This is a leadership and development programme for research leaders of the future and helps provide space and time to understand the importance of engaging with the public and media, to build interdisciplinary collaborations and to think creatively.

Filippo says: "Being in the team of the Scottish Crucible 2016 is a great opportunity to learn more about how to effectively translate my research into actionable strategies. This something we can sometimes overlook as scientists but is a key component of our mission: to understand Nature so we can better our living, working and social conditions."

SynBioBlog - SynBioBeta London 2016

Submitted by synbio on Tue, 04/12/2016 - 10:06

Edinburgh was well represented at this year's SynBioBeta UK 2016 conference on April 6th to 8th. This annual event goes from strength to strength and could soon outgrow its current venue at Imperial College London.

Attracting a very diverse delegation of academia, industry, investor and government it's a great event for catching up with existing collaborators, making new contacts and all while getting a birds' eye view of what's hot in synthetic biology.

This year, Edinburgh shared an exhibit stand with the other Synthetic Biology Research Centres (see picture) to provide a single shop window for the broad range of research ongoing across the UK. It was a great way to get the message out that we are open for business and that collectively the UK is punching above its weight in synbio thanks to the substantial investment from the UK Government over the past few years.

Having been to the last three SynBioBeta events it's great to see the progress of some of our home grown synbio startups such as Synthace and Synpromics, whose products and services are really starting to catch the attention of the marketplace. More established companies are also beginning to see the opportunity in synthetic biology and are steering their own services in that direction. There was a compelling track on the microbiome and companies interested in engineering strategies to address disease – something to watch for the future.

And full marks again to the SynBioBeta team for their creative stage decorating with their own version of genetic building blocks. Looking forward to April 2017 and what magic they can perform then.

Liz Fletcher, Centre Manager

SynBio Perspectives: Automation, expectations, and laboratory work - a robot in every lab?

Submitted by synbio on Wed, 03/23/2016 - 08:37

There is, so it is said, a coming wave of automation, with effects on everything from cancer surgery, to hotel concierge services to self-driving cars. As this most recent story about 550 job-losses through automating financial advice at RBS demonstrates, these issues are now more consistently hitting mainstream media thanks to their tangible real-world effects on people and institutions. This puts automatizing work in science and engineering in a much broader context, and leads me to the question: is everyone talking about the same thing when they talk about the rise in robotics and laboratory automation?

This was the backdrop to my participation at a recent synthetic biology workshop, 'Automation and Robotics for synthetic biology'. I went with the intention of finding out what automation meant to different people, what they were most excited about, and the problems they believed automation solved. Perhaps surprisingly, researcher-led in-house lab automation (within Universities) was seen as 'old school' in the opening presentation. Subsequent speakers, in contrast, envisioned the deployment of robots in every lab and focused on the challenge of changing the culture of scientists as labs

shift to a new paradigm of automated laboratory practice. A move towards Cloud-based and out-sourced lab services was presented as the coming trend in synthetic biology. Most of the workshop participants agreed that the future of biological research and engineering would be more automated, even if the scale, speed and location of those changes were yet to be decided.

Attendees ranged from academia to process management specialists, and included a significant component of industry representatives. The latter were particularly well represented (in comparison to perhaps other kinds of event), because the workshop was embedded in a 'scale up for synthetic biology' series, scoping out how to move biological research from lab to industry, and the roles for robots and automation in that process. Scale-up and automation were presented as having considerable overlap, as was also recently seen in the recommendations of the UK strategic plan for synthetic biology.

The role for robotics in science, however, covers more ground than academia-industry partnerships. This view was expounded in a presentation by a team working to develop the Robot Scientist. For this group of researchers, the automation of laboratory work is essential to understand the huge complexity of biological systems – they argue that human minds alone will not be sufficient. This is a fundamental problem in biological research, and it is one that is independent of delivering industrial synthetic biology products to market.

There is consensus among all these groups – committed industrialists or not – about the value of automation for increasing productive capacities within labs. What is still not settled is whether increased productivity should be applied to the expansion of experimental space in biological research (i.e. for increasing the capacity of empirical work to understand biological functionality) or if attention should be turned to re-aligning academic laboratory productivity to match up with the aims and expectations of industrial biotechnology. To ask where an academic field or set of technologies is headed is not idle speculation, because making promises about the future power of a technology, including lab automation, legitimises actions in the present.

One example of promises about technological futures legitimising actions in the present is the case of US Defence Department (USDD) budgeting after the Second World War. Applying the 'Programming, Planning, and Budgeting (PPB)' approach, the so-called 'Whiz Kids' of the RAND Corporation implemented operational research approaches into the USDD. These 'total systems analyses' (which consolidated the future budget requirements for all army, navy, and air force operations) put an end to the then established practice of top-brass commanders playing budgetary 'games'. That is, commanders would first get sign off for the 'thin edge of the wedge' and build a number of aircraft, then, subsequently, during the planes' construction, inform budget holders of the need for additional funding for bases, training, and tankers.

This example demonstrates how the promise of an aircraft for strategic defence planning (a speculation about future technological requirements) had significant implications for actions in the present (the construction of bases in the mid-20th Century). It also shows that to understand how large systems are organised – be that the budget of the US Air Force or capital investments for large-scale Research and Development – requires attention not only to the technical specificity of the system in question, but also to the social dimensions that shape decision-making around technology adoption. This is because when applying the total systems approach the Whiz Kids were not just envisioning a more productive and efficient

way of organising the US military but also, in deploying the PPB method, these new entrants to the USDD top brass disrupted established hierarchies of authority. We can also therefore ask: what claims are being made about *automation's* future, and for whom do these futures help in the present?

For the participants discussing automation at the recent workshop, robotics represented more than simply an extension of human capacities in the lab. The 'new paradigm' mentioned earlier invoked not just a change to the hands-on, craft nature of biological research at the bench, but also a change to the forms that such research can take: "question all existing assumptions" was the plea from SynbiCITE's head of automation. This paradigm shift in the nature of laboratory work seems to coincide with the scale-of-change envisioned through automation in society more generally. In this respect robotics and automation are not only positioned as a necessary next step for enhancing biological research, its reproducibility, and commercialisation, but also as a major disruptive technology for years to come.

In addition, according to some workshop contributions (especially during Q and A sessions), the desirability of automation in biological research is currently eclipsed by the challenges that remain in understanding complexity in how biology functions. For these contributors, understanding biology is still the main goal in an academic research laboratory. All this is to say automating even simple lab processes is tricky. So why bother? Some of the presenters at the workshop clearly see commercialisation as the way to ensure synthetic biology has a future in times of substantial economic challenge. Others seemed more concerned with the opportunities that automation may bring for expanding the experimental space of biology.

In many ways the workshop raised more questions than answers. For example, how are laboratory users situated in workflows that incorporate automation technologies and commercialisation? Is this future of fully automated, technological biological research an inevitable one? And, do those who resist such changes risk being labelled as modern-day Luddites?

I know from experience working alongside current researchers in labs that automated technologies are everyday tools in their work; they provide data points and help scientists to construct empirical cases of biological function. It is in this potential (for expanding the experimental space of biology) that the lab users I've encountered see as having most value when thinking about the adoption of automated workflow technologies. Whether or not such potential becomes entangled with industrialisation and commercialisation efforts does not seem settled, even if documents like the UK Strategic Plan appear to reinforce this narrative. The story of laboratory automation, therefore, has multiple protagonists, each with their own back-story; just as the Whiz Kids were able to plan, programme and budget their away around the military's budgetary games, will there be a system-wide overhaul of the nature of laboratory work, or will the promises of automation being made now seem quaint to future laboratory users?

The current community of researchers in biology seem well placed to offer perspectives on the issues raised here. I would be grateful for views and comments, so please get in touch if laboratory automation is a relevant issue in your work. Thank you.

Chris Mellingwood is an EPSRC-funded PhD student in Science, Technology and Innovation Studies (STIS) in the School of Social and Political Sciences at the The University of Edinburgh.

Royal Society Award for Innovation

Submitted by synbio on Thu, 03/10/2016 - 08:32

March 10th 2016

Dr Teuta Pilizota, a Chancellor's Fellow at the School of Biological Sciences and member of Centre for Synthetic and Systems Biology has won one of several Brian Mercer Awards for Innovation from the Royal Society. Dr Meriem el Karoui, also a Chancellor's Fellow at the School of Biological Sciences, is a co-Investigator on the Award.

The Brian Mercer Feasibility Awards are given to scientists who wish to investigate the feasibility of commercialising an aspect of their research. Teuta wins ~£30K for her research to design a microfluidic platform that will enable automated imaging of individual bacterial cells (including product accumulation) during different stages of the bioindustry production process. This will address the lack of online information available to industrial biotechnologists when assessing product quality and quantity and will transform assessment of compound production. It is estimated that currently only about 3-4% of all chemical sales have been generated with some help from industrial biotechnology (IB). New tools and technologies are needed to enable IB to deliver and succeed in transitioning from resource intensive and environmentally costly chemicals production to next generation bioproduction.

The prize is being presented at the annual Royal Society *Labs to Riches* event in London on March 10th where there will be a keynote address given by the entrepreneur and philanthropist Baroness Martha Lane-Fox. The evening brings together leading scientists, engineers, industrialists and policymakers to celebrate the achievements of some of the UK's brightest and most innovative researchers. The event will focus on the theme of entrepreneurial risk and reward, and will explore how science and innovation systems can best support and encourage entrepreneurial success, strengthening the case for the importance of science and industry to economic growth and productivity.

Edinburgh Genome Foundry installation begins

Submitted by synbio on Thu, 03/03/2016 - 12:16

In early February a newly refurbished laboratory space on Swann Level 2 was handed over to the Edinburgh Genome Foundry team. This purpose built facility is now ready to be the new home for the Edinburgh Genome Foundry, an automated platform for construction of large scale DNA.

Installation of the automatic work cell has by Thermo Scientific commenced on February 15th and today most of the hardware is in place. Although some hardware components remain to be installed, the engineers are working hard to train the three industrial sized robotic arms to interact with individual pieces of equipment. The whole process will continue for the next month or so and will likely be completed by the end of April. The EGF team has been working on developing protocols for DNA assembly on individual pieces of equipment and so we hope by May we'll be able start using the robotic work cell for automated DNA assembly. We are expecting to assemble first DNA by July and will be open for business later in 2016.

Photos: The newly refurbished laboratory in the Michael Swan Building (left) and ongoing installation of the robots workcells (right)

Next steps for synthetic biology – scale up and automation

Submitted by synbio on Thu, 03/03/2016 - 11:53

Several members of SynthSys headed to a cold and sunny Manchester on 24th and 25th of February to participate in two workshops run by the Knowledge Transfer Networks on 'Effective Scale-Up' and 'Automation and Robotics.'

The first day focused on the potential opportunities for synthetic biology in the scale up of processes from the lab bench to the production setting. While we might persuade synthetically engineered microbes to behave nicely in the lab, these local conditions rarely scale neatly for the production of economically viable yields. Careful consideration needs to be given to the selection of the right chassis, developing the right media feed stocks and ways to optimise separation of the valued product. As Robin Mitra of the Centre for Process Engineering summed it up "it's all about stress management in the microbial workplace." Speakers from academia and industry discussed their own strategies to optimise microbial productivity, including: custom-designed promoters (Synpromics), using engineered cells as internal detectors of the local environment (Karen Polizzi, Imperial College London), engineering novel chassis (e.g. Horizon Discovery and John Ward, UCL). There was an interesting final discussion on the techno-economic analysis that needs to be done to ensure that bioproduction is actually economically viable for some products (Katie Chong, European Bioenergy Research Institute).

Day two took a broad look at the fast moving world of automation and robotics in synthetic biology. Miniaturisation and automation will relieve researchers of much of the 'sweat equity' involved in synthetic biology and free them up for more creating and planning time.

Simple, user-friendly and inexpensive devices for circumventing tedious repetitive work are high on the wish list. Many forsee the time when there will be a robot in every lab.

SynthSys Director Professor Alistair Elfick introduced the day with his own perspective of what sort of automation and robotics were needed for synthetic biology. Dr Richard Hammond from Cambridge Consultants provided an interesting historical perspective of the role of automation in almost every advance in society over the past century it being "essential and not an add-on" for progress. There are many reasons to automate a process, not the least to help us address the reproducibility crisis in experimentation. More than that, automation is a new paradigm that allows us to rethink every step in a process, question our assumptions and even do our science differently. "It's about inspiration not perspiration," says David McClymont, Automation Manager, SynbiCITE. Robotics and automation certainly capture the imagination. Dr Patrick Cai provided an overview of the platform currently being established in the Edinburgh Genome Foundry and in particular the cost and time benefits of acoustic dispensing with LabCyte's ECHO system [which incidentally lends itself to some creative applications, and see photo]. Several commercial providers of automation equipment discussed their products and were actively interested in working with the community to help develop products that meet its needs.

There was plenty of time for the organisers to collect opinions on what the challenges and opportunities in both these area of synthetic biology and we look forward to what that might mean for future support for this area.

SynthSys is hosting LabCyte's "Acoustic Genomics Symposium" here in Edinburgh on September 28th to 29th 2016.

Photo courtesy of Labcyte showing the lighter side of acoustic dispensing in synbio labs.

SynBioBlog: You can’t beat the benefits of a face-to-face

Submitted by synbio on Tue, 03/01/2016 - 15:04

Dr Hannah Florance, Metabolomics Specialist, Centre for Mammalian Synthetic Biology

The value of seeing the ‘whites of the eyes’ of a potential collaborator really hit home over the past week when I went to the US with the Rosser Lab to visit three synthetic biology labs.

I was recently employed in Edinburgh as the resident metabolomics specialist. After speaking to several potential users of the facilities here, I quickly realised some of the analyses required would need a lot of work-up. So it made sense to connect with some of the experts in the field to learn from best practice.

Our first stop was the Joint Bioenergy Institute (JBEI) in San Francisco and then we flew back east to Boston to visit The Broad Institute and Ginkgo BioWorks. We wanted to gain first hand insight into how the groups run their facilities – the instrumentation, the personnel and their approach to synthetic biology as a whole.

Walking and talking experimental workflows in these labs provided many useful nuggets of information – experimental tips and tricks, and ways to trouble shoot analytical anomalies. Alone these insights have probably saved me months of method development. I doubt a chat on Skype with someone I’d never met before would have been so enlightening. All the groups were remarkably open and willing to share their expertise and experiences – the good, the bad and the ugly.

Our whirlwind tour opened my eyes to the scale of what can be achieved, sometimes with just limited resources. Even if we don’t work on the scale of bespoke automation at Ginkgo (who incidentally started out with the most miniscule budget) the big picture is entirely apposite and inspiring. Travel and exposure to different attitudes opens the mind. Having met the relevant people in the flesh, I now feel I can contact them anytime. Cementing relationships with these groups has served to gain a trust, and consequently a willingness, for knowledge transfer and potential future collaborations. I will look forward in turn to sharing my experiences in setting up and running a metabolomics lab with others in the community looking for advice and support.

Biology by design – the road ahead for UK synbio

Submitted by synbio on Tue, 03/01/2016 - 14:57

On February 24th George Freeman MP, Minister for Life Sciences, launched the long anticipated UK Synthetic Biology Strategic Plan 2016 and so set the stage for the next chapter in the growth and investment in this fast growing sector.

The report entitled *Biodesign for the Bioeconomy* builds on the original roadmap for synthetic biology first published in 2012, and puts synthetic biology at the heart of the growth of the bioeconomy. The aim is to build a £10 billion market by 2020 at the heart of which is the ability to redesign cells and systems for a wide variety of useful applications in health, chemicals, energy, food and materials.

The original strategy did much to promote synthetic biology as a valuable new technology platform and investment followed. Synthetic biology found an articulate champion in the Right Honourable David Willetts (then Minister for Universities and Science and now Lord Willetts) as one of the UK's 'Eight Great Technologies', and largely thanks to his energy it has benefited by more than £300 million in government investment and substantial private funding too.

Almost all of the recommendations of the original roadmap were realised through the establishment of six centres of synthetic biology research, a network of DNA synthesis facilities, an innovation and knowledge centre (SynbiCITE), a £10 million (Rainbow) seed fund for start-ups, and a Doctoral Training Centre. UK synbio is now the envy of many other developed nations with an investment only second to the USA. The world has been watching us. So perhaps no surprise that the recording of Freeman's speech quickly went viral globally as thousands tuned in to find out what next.

The refreshed roadmap take stock on the road travelled thus far and focuses on what is now needed to realise an economic return on that substantial investment made. It is a simple five point plan: There is a focus on accelerating commercialisation and industrialisation, in particular around ensuring that platform technologies enabled by synthetic biology can be translated into improvements in manufacturing efficiencies. There is awareness of the need to ensure we have a suitably skilled workforce, armed with the knowledge and expertise in biodesign to actually translate the potential of synbio into tangible benefits. The need for integrated governance and regulation gets the nod it rightly deserves as the social impact of 'engineering life' requires careful handling. Finally, there is the need to ensure that 'SynBio

UK' does not become too parochial and that we continue to look both east and west for collaboration and cooperation.

The road ahead for synthetic biology is at least mapped out and paved with good intentions. The final destination is a rejuvenated manufacturing sector, growth of new and exciting markets, clusters of dynamic start ups and thousands of highly skilled new jobs. We can only hope that public and private investors can dig deep to help keep up the momentum we have built to keep the UK's pole position in synthetic biology.

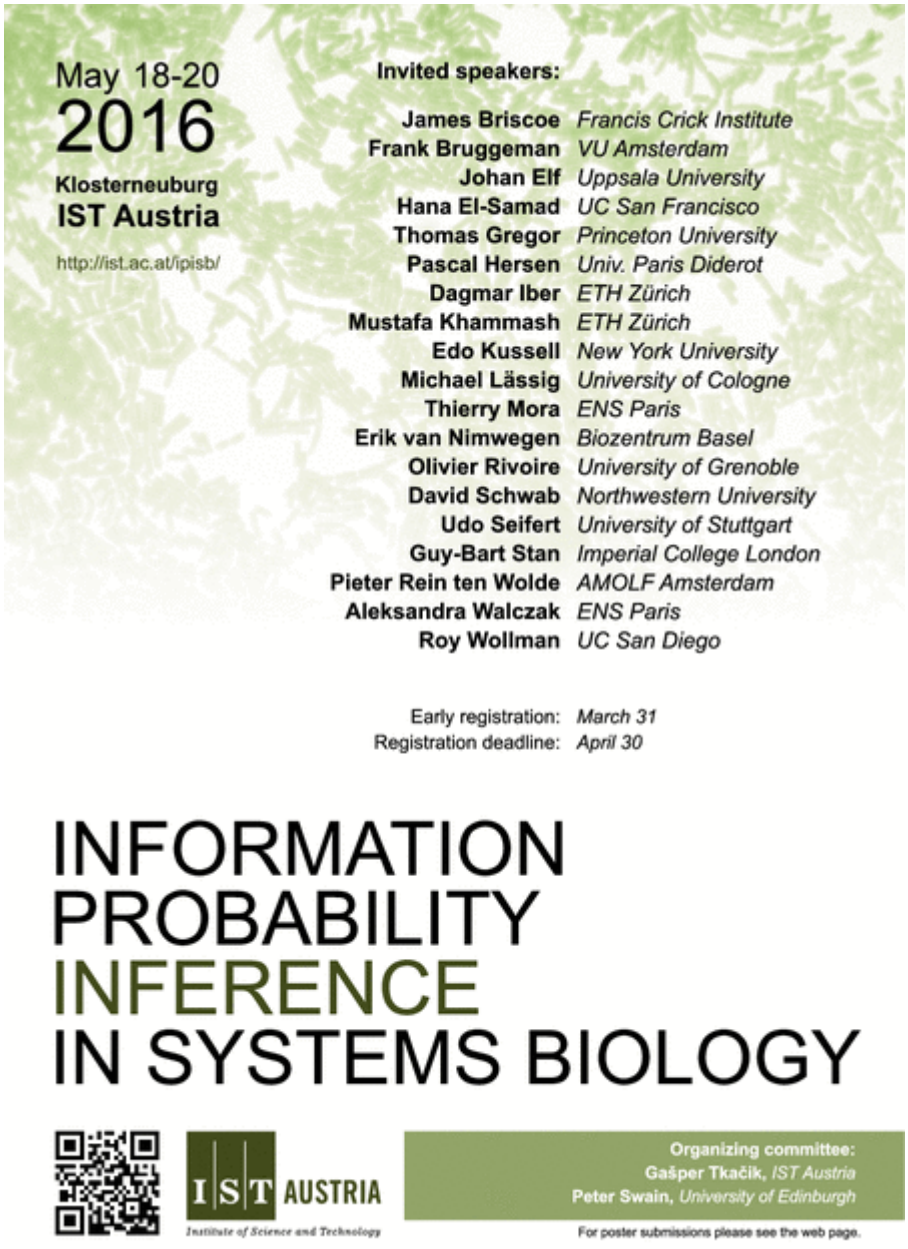
You can watch George Freeman MP, Minister for Life Sciences at **https://vimeo.com/157133305** and download the **Strategic Plan**.

The Information, Probability and Inference in Systems Biology Conference

Submitted by synbio on Tue, 02/23/2016 - 11:36

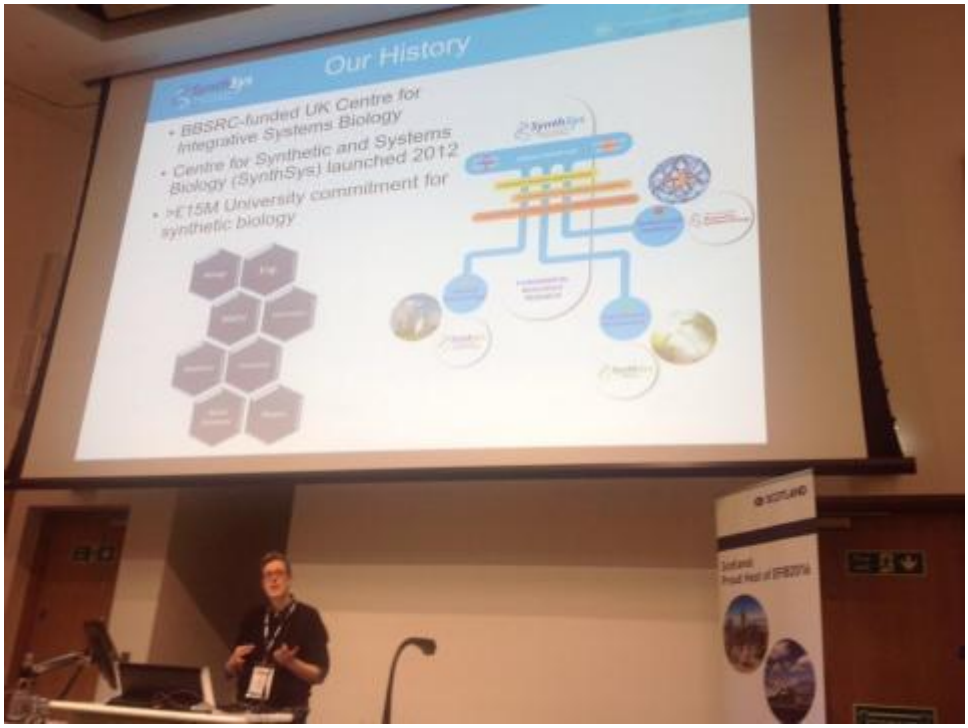
Synthsys Associate Director, Professor Peter Swain, is co-organising **The Information, Probability and Inference in Systems Biology Conference (IPISB2016)** which will be held from May 18-20, 2016 at IST Austria in Klosterneuburg, Austria.

Full information and registration at http://ist.ac.at/ipisb/



SynthSys exhibits at the annual Industrial Biotechnology Innovation Centre Conference

Submitted by synbio on Tue, 02/02/2016 - 13:01



SynthSys showcased its research activities and industry partnerships to over 400 delegates attending the annual conference of the Industrial Biotechnology Innovation Centre (IBioIC) in Glasgow on January 28th and 29th.

Professor Susan Rosser, Director of the Centre for Mammalian Synthetic Biology, chaired a session on the challenges and opportunities arising from synthetic biology. Susan provided examples of how synthetic biology is being applied at SynthSys to industrial biotechnology (IB) applications and highlighted the comprehensive suite of technology platforms that it can offer collaborators.

Building on the success of the first year, the second annual conference of the IBioIC was aptly title 'Realising the Opportunity' and an excellent opportunity to review progress and assess the challenges and opportunities in this multibillion dollar marketplace.

The Conference included sessions on the global landscape for IB examining the opportunities and challenges facing the industry in the future, not the least funding, skills shortages, the drop in the price of crude oil, and the regulatory environment. Indeed, Professor Joyce Tait of Innogen and SynthSys discussed the very different needs in winning hearts and minds when it game to acceptance of rapidly emerging technologies like IB.

One of eight Innovation Centres funded by the Scottish Funding Council, IBioIC has been a valuable initiative for Scotland and is core to the Scottish National plan for IB. Scotland has

an ambition to have 200 companies involved in IB by 2025, employing 2,500 staff and with an estimated turnover of £900M. The remit of IBioIC is to provide the tools, skills and partnerships to support the growth of the sector.

The University of Edinburgh was a founding partner of the IBioIC and SynthSys PIs have been active participants. SynthSys Commercial Relations Manager, Dr Lorraine Kerr works closely with IBioIC and its industry members to facilitate connections to University of Edinburgh researchers.

The Centre has benefited from the many opportunities to network with industry and has developed many industrial partnerships as a result. Since the inception of the IBioIC, Edinburgh has been awarded funding for five collaborative projects (worth > £0.5M in total) and nine PhDs, and has forged numerous relationships with both SMEs and multinationals.

IBioIC has been influential in bringing the European Federation of Industrial Biotechnology (EFIB) annual event to Glasgow in October 2016, helping to put the UK on the IB stage globally.

For further information about IB opportunities at Edinburgh please contact Lorraine Kerr (Lorraine.Kerr@ed.ac.uk or 0131 651 9070).

Prestigious appointment for Mammalian Synbio Centre Director

Submitted by synbio on Mon, 02/01/2016 - 09:19

Professor Susan Rosser, Director of the UK Centre for Mammalian Synthetic Biology, has been appointed a member of the Scottish Science Advisory Council (SSAC).

The SSAC is an important source of science advice to the Scottish Government alongside the Chief Scientist (Health) and the Chief Scientific Adviser for Rural Affairs, Food and the Environment. A new Chief Scientific Adviser for Scotland is currently being recruited.

Susan joins several other academics from the University of Edinburgh including: Dr Tara Spires-Jones, Reader and Chancellor's Fellow; Professor Anna Meredith, Professor of Zoological and Conservation Medicine; and Professor Andrew Mount FRSC, Professor of Physical Electrochemistry and Dean of Research for the College of Science and Engineering. Almost half of the Council are women, which is a positive move towards raising the profile of women in science and technology.

The SSAC will be chaired by Professor Paul Boyle CBE FBA FRSE, President and Vice-Chancellor, University of Leicester.

Susan's appointment is for two years, from 1 February 2016 to 31 January 2018.

The first meeting of the new SSAC will be on 4 March, 2016 and will focus on the SSAC's priorities for the next two years.

Further information can be found on the SSAC website. http://www.scottishscience.org.uk/article/announcement-new-ssac-members

Welcome to the new SynthSys Director

Submitted by synbio on Tue, 01/19/2016 - 08:38

Professor Alistair Elfick of the University of Edinburgh's School of Engineering has become the new Director of SynthSys.

Alistair holds the Chair of Synthetic Biological Engineering and has played a key role in raising the profile of synthetic biology at Edinburgh. He has been an instructor on the Edinburgh iGEM team for several years, was Director of one of the original BBSRC Networks in Synthetic Biology and is also Depute Director of the newly established UK Centre for Mammalian Synthetic Biology.

Alistair considers himself a 'proper engineer' with a Degree in Mechanical Engineering, but was soon lured by biology into a Doctorate in Biomedical Engineering, which explored wear of orthopaedic implants and subsequent immune reaction. At the moment, Alistair is currently working in measuring technologies including label-free optical spectroscopy/microscopy, and automation of assays. He is also keen on exploring the wide context of synthetic biology and played a key role in the 'Synthetic Aesthetics' project, which brought together synthetic biologists, designers, artists and social scientists to explore the implications of adopting biology as a material to design.

"I excited to take over as Director of a vibrant and successful Centre, and to work to maintain our momentum at the forefront of Synthetic and Systems Biology."

Synthetic biology is a highly multidisciplinary area of research that necessitates interactions across several Schools and Colleges. To help build bridges between the different disciplines the Centre has a rotating directorship to reflect this. Alistair takes over from Professor Peter Swain from the School of Biological Sciences.

You can find out more about Alistair's research interests here.