

## Message from ESP Director A/Prof Anjam Khursheed



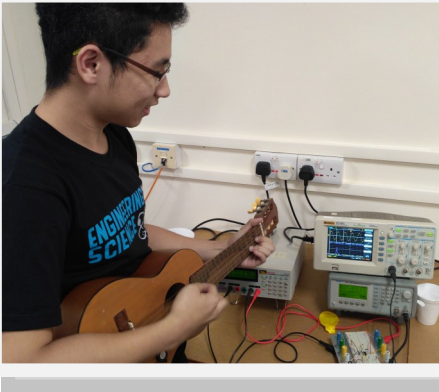
I am pleased to inform our students that there are many good new developments in ESP in the pipeline, such as the new Engineering Science in Medicine specialization has been approved and a much stronger Computer Engineering Science (CES) specialization that now includes topics like programming, robotics and control. The overall direction of engineering education in the future is a multi-disciplinary one, that has the characteristics of STEM education (Science, Technology, Engineering and Mathematics), and ESP is already there. Many prestigious universities in the world have recently created engineering science/physics degree programs, and there is no reason why ESP should not move forward with confidence. I want to assure you that our ESP programme can prepare students for a successful career. The opportunity is there, but

like everything else, in order to succeed, students must take charge of their own education. ESP aims to give them a multi-disciplinary education with strong science fundamentals combined with cutting edge engineering applications, one that targets first-hand experience in things. Their potential future employers will look for what they have in their first-hand experience, such as the skills and things they have developed in projects. Employers will also look for a strong interest in learning, and how open they are to learn new things. Students must make sure that they gain first-hand experience in whatever projects they do. If students do the CES specialization, they must make sure that they have written code for an interesting application. If they take the Nano specialization, they must make sure that they have grown some nano-structures, and know how to use microscopy tools to inspect them. Whatever specialization students choose, they must make sure that they gain hands-on experience of it.

## ESP Director, A/Prof Anjam Khursheed would like to wish all ESP Students & Staff a Happy & Prosperous Lunar New Year

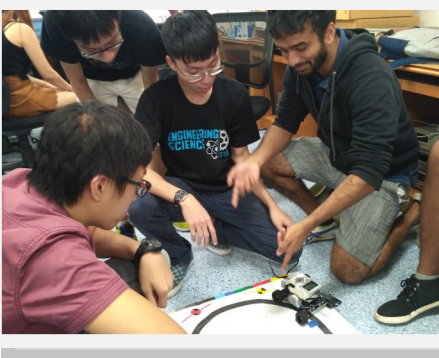


## The new ESP-ECE Faraday Lab



We have now relocated the old WS2 Innovator's Lab to block E4, 2<sup>nd</sup> floor, and it is shared with the department of Electrical and Computer Engineering. Its new name is the Faraday Lab, in honor of the 19<sup>th</sup> century British engineer-physicist Michael Faraday, who discovered many of the founding principles to electromagnetism as well as inventing engineering devices such as the world's first motor, generator, and transformer. One key ingredient in Faraday's success was the way he was able to answer fundamental questions in physics by carrying out ingenious experiments. Our new lab celebrates the success of his hands-on approach. The Faraday Lab is designed to be a place where students can carry out innovative hands-on projects, a place where they gain first-hand experience of science fundamentals and engineering principles by designing and making devices for themselves.

One of the first courses taking place in the Faraday Lab is the first year module, ESP1104A Sensor System Electronics. In this module, students build their own complete audio system, from microphones/guitar pick-ups, amplifiers, filters, through to loudspeakers. The picture above shows a student analyzing the time and frequency response of a piezoelectric vibration sensor mounted on to a small classical guitar.



Another module taking place in the Faraday Lab this semester is the first half of ESP2110 where students build their own robots and program them to follow a zig-zag black line. This module enables students to learn the basic principles of a simple control system, known as a PID feedback controller. They build the system up by themselves from Lego Mind-Storm kits. The PID controller principle is used in the second-half of the module where students learn how to control the tens of nanometer distance between a homemade Scanning Tunneling Microscope tip and a metal sample in order to obtain quantum tunneling current. The picture next to it shows students setting up a robot to follow a black line elliptical track.

## Student exchange and Internship opportunities in ESP

ESP continues to provide student exchange opportunities with its partner universities. This academic year, over 50% of the 2017-18 cohort are going on student exchange, and the majority are going to our partner universities, University of Toronto, Canada, Royal Institute of Technology (KTH), Sweden, and Osaka University, Japan. There are also 12 week Vacation Internship opportunities with Osaka University (OU) and the University of British Columbia (Okanagan Campus). Osaka University provides our ESP students a stipend of 200,000 JPY and the University of British Columbia will be able to offer in-kind remuneration in the form of :

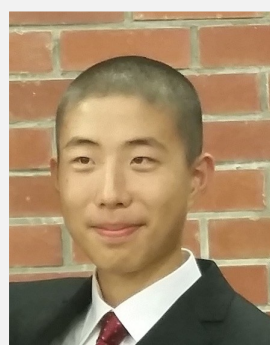
- ◇ Accommodation at the University's residences, U-Pass for unlimited use of Kelowna public transit and iMed health insurance during the internship period
- ◇ C\$700 top up in the intern's UBC Card which can be used for purchasing food and groceries on campus

Click below to learn more about the International Engineering Science Consortium and our partner universities:

<http://www.engineering-science.org/>

Read about the students' learning and enriching experiences here (page 5), [http://www.esp.nus.edu.sg/newsletter/newsletter\\_files/2017/PULSE%20September%202017.pdf](http://www.esp.nus.edu.sg/newsletter/newsletter_files/2017/PULSE%20September%202017.pdf). Students who are interested to find out more about the internship programme, please email Ms. Violet Tay at [espttlv@nus.edu.sg](mailto:espttlv@nus.edu.sg) for more information.

## An Interview with ESP Student Lou Beicheng



# ESP

student Lou Beicheng is anticipated to set a record for completing the ESP, GEP, a double major in physics and a minor in computer science all together. This is a remarkable achievement since each component is a feat by itself. ESP quizzes him to find out how he could achieve so much in so little time.

### Q1: Before you join NUS, where did you study and how did you know about NUS?

I graduated from Hangzhou Foreign Languages School. I came to know about NUS through the SM2 Scholarship program. As NUS is a world class university and Singapore is an attractive modern place, I did not hesitate to accept the offer to read ESP in NUS.

### Q2: How do you manage to handle the rigorous ESP, accelerated GEP, the double major in physics and a minor in computer science?

To be accurate, my minor in CS has just started and so I have not handled all of it yet. For the other three programmes, I am grateful for the flexibility of ESP and the supportive administrative team. The most formidable task is how to work out a possible curriculum to cope with all the requirements of the programmes. Thanks to the trust of A/Prof Khursheed and the help from ESP office, my proposed curriculum plan was made possible. The next step is to get the other faculties to allow me to take modules without the pre-requisites. One has to do a lot of self-study to bridge the knowledge gap. This task is made easier because ESP is famous for its small student cohort and the conducive learning atmosphere that bring students together to help one another and to understand advanced course materials. Finally, one has to obtain excellent grades for the modules taken so that your module overload request gets granted for the next semester. For that, good time management is needed. I am very bad at time management, but fortunately, I have neither CCAs nor girlfriend around, so I have plenty of time to study no matter how poorly I manage my time. Of course, I am not saying CCAs and girlfriends are less important, but that is how I survived. I sincerely hope to see juniors achieve more than that!

### Q3: Why do you like these programmes?

I started with GEP very early to make undergraduate life more challenging. While in ESP, I found quantum computing rather interesting and I wish to contribute to this field. To excel in this field, a solid foundation in physics, especially in quantum physics, is needed in addition to the engineering background. This led me to do a double-major in physics and plan to pursue a PhD in physics as well. As the name suggests, quantum computing also requires knowledge from computer science and I am also interested in that subject; so I started a minor as well. In short, all these interesting programmes are very helpful in equipping me to better contribute to the society.

### Q4: What do you plan to do after graduating from NUS?

I plan to pursue a PhD in physics, followed by a career in the realm of quantum computing. I hope to help develop the related technology and bring forward new and exciting applications.

### Q5: What do you hope to become in future?

A versatile engineer scientist who helps to change the world for the better.

### Q6: What is your most memorable experience in ESP?

Too many! For a short one, I recently went to Toronto under the student exchange programme with seven other ESP students. We stayed in the same house, enjoying life together. I strongly felt the sense of belonging and ESP is indeed a closely-knit family.

### Q7: Who is your favourite teacher in NUS and why is he/she your favourite?

The question is too hard to answer since all ESP professors are great and I really appreciate their teachings. Prof Wang Chien Ming and A/Prof Anjam Khursheed are always very encouraging. Prof Tan is very patient and helpful. A/Prof Zhang Chun is rigorous but approachable. A/Prof Jeroen, A/Prof Bettiol, A/Prof Ho and Huei Ming made the nano-class very lively and enriching. Dr Shen Lei is very caring. If you let me continue, I will name all the professors.

### Q8: Any advice to future ESP students who wish to follow in your footsteps?

Yes! Life is short. You only come to university once. Take risks and try hard. Challenge yourself and bring out your full potential. Never stay in comfort zone. Appreciate people around. And please don't "follow in my footsteps" since I know a lot of people better than me. Everyone has a different standard for success and a different goal for life. Just stick with your passion and keep going!



## ESP Researcher wins IChemE Energy Award 2017



*A/Prof Chua Kian Jon Ernest is recipient of IChem Energy Award 2017*

In recognition of his research effort and contribution to Energy and Sustainability, A/Prof Chua Kian Jon Ernest, ESP Associate from NUS Mechanical Engineering, was conferred the IChemE Energy Award 2017 on 19 October 2017. A/Prof Chua and his team have developed a new approach that leads to the liberation of hydrogen and oxygen from waste-water in a remarkably energy efficient manner. It consists of a triangular hybrid set-up comprising electrolysis, photocatalysis and photovoltaic cells. The implementation of such a hybrid system increases not only the hydrogen and oxygen production rate, but employs the least energy, hence making the method truly renewable and sustainable.

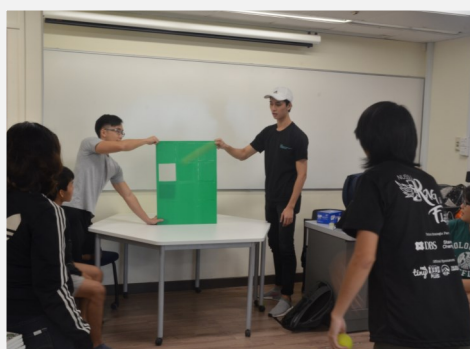
The oxygen and hydrogen produced are harvested and applied to evolve an Advanced Air Treatment System (ATS). The ATS – includes an ozone generation system generated from the harvested oxygen – is capable of achieving a dualistic function of air treatment and cleaning of chilled water heat exchanger in air-conditioning systems. The entire ATS is highly sustainable. It employs solar irradiation, PV panels, and rainwater to produce oxygen, which converts to ozone for treating pollutants (such as VOC, formaldehydes, benzene, radon, asbestos), while enriching the supply air with higher oxygen content. In addition, the harvested hydrogen may be employed to generate electricity via fuel cells in order to operate blowers and controlled valves of the ATS. The team has engineered an innovative and sustainable energy system. It is one that produces hydrogen and oxygen in a highly efficient manner, while utilising the gases to supply power to air conditioning equipment and purify indoor air pollutants.

## Meet the Mentor session



ESP held a *Meet the Mentor* session on the 12<sup>th</sup> January 2018. It was a great opportunity for the students to meet their mentors as well as their fellow ESP mates from the other cohorts. The session started with ESP Director A/Prof Anjam Khursheed briefing students on the exciting developments that ESP has come up with, especially on the new Engineering Science in Medicine specialization. The students then broke up into small groups where they got to know one another better. ESP looks forward to holding more of such bonding events in future.

## ESP Safety Day



The ESP Safety Day was held on the morning of 29<sup>th</sup> September 2017, a day that was designated as the Faculty of Engineering Safety and Health Day. Every department in the Faculty held their own Safety Day events in the morning and it all culminated in the afternoon with the events planned by the Faculty Safety Unit. Our ESP's Safety Day would not have been a success if not for the efforts put in by the Students' Sub-Club Committee. ESP Director, A/Prof Khursheed, kicked off the event with his short speech on "Safety in the Labs". After which, the students began the safety-themed games that had been carefully thought up by the Sub-Club Committee Members. After a few rounds of the games, all students adjourned for a tea-break session outside the ESP Office with catered refreshments.

## ESP Researcher wins the IET's Distinctive Innovation Award 2017



*A/Prof Chua Kian Jon Ernest is the recipient of the IET (Institute of Engineering Technology, UK) Innovation Award 2017  
Background: Innovative Hybrid Membrane and Composite Desiccant System)*

For his research on energy and sustainability, ESP Associate, A/Prof Chua Kian Jon Ernest was awarded the “Institution of Engineering and Technology (IET) Innovation Award 2017” on 15 November 2017. A/Prof Chua and his team have developed a novel hybrid method that improves air dehumidification to achieve very low air dryness. The hybrid method comprises an integration of a composite desiccant and a nano-woven membrane for air dehumidification. The solution complements any building HVAC (Heating Ventilation and Air-Conditioning) project, where removing moisture from the air via energy-efficient means is a concern. Longer sustainable performance of the composite desiccant is achieved, as the non-regenerative membrane assists in partial air dehumidification. Accordingly, the hybrid system requires a lower regenerating temperature, while producing air of very low humidity spanning 5 to 7 g/kg dry air. The proposed hybrid solution involves the composite desiccant and membrane to work in tandem to achieve enhanced moisture removal capability, and obtain improved energy efficiency by up to 40% compared to the best grade commercial desiccant dehumidification.

The widespread adoption of the hybrid dehumidification solution will reduce the energy consumption by removing moisture from humid air. This dehumidification innovation has great potential for confined spaces and mobile applications, where removing moisture from the moist air to reach very dry condition is critical. Applications that require humidity control include high-value products, such as jewellery, museum artefacts, and for the sustainable operation of delicate equipment in field hospitals, data centres, armoured personnel carriers, operation decks of navy ships and aircrafts.

## Farewell to A/Prof Joshi Shailendra

ESP said “Goodbye” to A/Prof Joshi Shailendra with the presentation of an appreciation gift by Director, A/Prof Anjam Khursheed on 15 December 2017. Joshi has joined the Department of Mechanical Engineering, Houston University. During his 9 years stint with ESP, he was involved in the teaching of modules, ESP2106 Principles of Continua and ESP4206 Continuum Mechanics. Joshi is a zealous educator. ESP certainly feels a tinge of sadness with his departure. We wish him all the best in his future endeavors.



*Left to Right : A/Prof Anjam Khursheed (ESP Director),  
A/Prof Joshi Shailendra and Prof Phan-Thien, Nhan  
(Head, ME Department)*



## An Interview with ESP Alumnus Au Khai Xiang



Alumnus Khai Xiang is ESP's first Ngee Ann Poly engineering science diploma graduate. He graduated with B.Eng (Engineering Science) first class honours in 2017. He was the prestigious J N Reddy Book Prize for topping the class in the final year. Below ESP interviewed him on his experience and thoughts on the programme.

### Q1 : Brief us on your ESP background

I joined ESP in AY14/15, the year of ALS ice bucket challenges to raise awareness for the disease. I graduated in July 2017, the year of US teens eating laundry pods. My specialization was Computational Engineering Science.

### Q2 : That meant you graduated in 3 years instead of the usual 4, why was that?

I came from a polytechnic (Ngee Ann) and so I had some exemptions. I also did an APC in Biochemistry, which helped push forward the curriculum and I could clear modules faster. Interestingly enough, I was originally set to graduate in 2.5 years because I joined GEP as a poly student. I stayed with the program by overloading for 1.5 years until I came back from exchange. Realizing that I had to do 5 modules + FYP in both semesters of the final year, I dropped out of GEP as I did not find that half a year of difference to be appealing enough a reason to overload. I preferred to take a bit more time so that I master the module contents better. (Also my scholarship was tenable for 4 years so I was like eh)

### Q3 : How was your experience with ESP?

I think I ought to preface this answer by saying that I enjoy learning and academic challenges. I enjoy not knowing, not knowing what I know not, slowly climbing out of that hole, just to find myself in another hole. With that, ESP was pretty good! The modules are really diverse and interesting. Though sometimes quite difficult, they stretch you into a versatile and technical thinker. The design projects were coin flips; sometimes they are pleasant, sometimes less so. In retrospect I have learnt a lot about applications of STEM, project management as well as working with other people. ESP is great to its students too (not sponsored to say this). I love the administrative staff; they were stars throughout my time in NUS. I have also met some of the brightest and/or nicest people in ESP. Though we are few, a small community is also a tight community, something not to be taken for granted.

### Q4 : How did you find your CES specialization?

I loved it. CES is probably the most important thing that happened to me in my academic journey. I have always loved mathematics, physics and coding, though not clearly any one more than the other two. I could not say with conviction that I wanted to be a pure mathematician, or a pure programmer, or a pure physicist. I wanted all of it, yet I needed to choose, be it in future academia or industry. It was through CES that I found my passion in applied mathematics and computation. CES takes the generality of mathematics and applies it to the vastness of science and engineering through efficient code implementations. For me it felt like it was a match made in heaven. I think it is also in perfect alignment with how technology is progressing and I could feel in touch with the purity of the subjects, that which our intellectual predecessors left for us.

### Q5 : Easiest ESP module?

ESP1107 (I think it's now 2107). It just made a lot of sense to me and Erik did a great job teaching.

### Q6 : Toughest ESP module?

A tie between PC2133 Applied Solid State Physics and PC1433 Mechanics and Waves. To this day I have little clue what was happening in both modules.

### Q7 : Favourite ESP module?

MA1508 Linear Algebra. It changes the way I thought about systems and its proofs are hauntingly beautiful. With linear algebra, one unlocks the door to computation, algorithms and data, which is in modern standards, everything that matters. It is the mathematics of the 21<sup>st</sup> century. 11/10 please do well.



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**Q8 : Craziest thing you have done in NUS?**

I am not sure if this is good PR. In my final semester, I took 4.5 shots of whiskey right before taking a final paper. And I am not a drinker. My favorite part about whiskey coke is coke. Fun fact: it was another ESP student who sponsored the whiskey. I got an A-, he got less whiskey, and we both got a fun story to tell.

**Q9 : Looking back, what is ESP to you?**

ESP is tabula rasa (blank slate). You can define yourself in ESP by choosing what you enjoy, whilst training on a rigorous curriculum of physics and engineering. If you want to do solar science, take more physics. If you want to do robotics, take more systems engineering. If you want to do business, take more day-offs. Make use of the magnitude of freedom we have and apply to it a direction (if you're following, you should get a vector). In short, ESP helped me discover my essence, in the Sartrean sense.

**Q10 : What are you doing now, and why?**

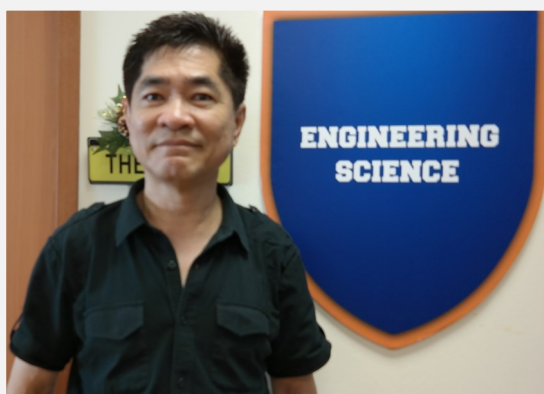
After graduation, I did not find a job immediately as I wanted to take a break. I have worked hard for 3 years so I gave myself the luxury to sit and stare at the wall for a few months. In this time, I started to apply for graduate schools for scientific computing courses, both local and overseas. Oxford, Cambridge and Imperial rejected me for their Masters/PhD Program. I believe it was because I wrote poor proposals and statements. UCL accepted me but I rejected it. In the meantime, I started to pick up machine learning and deep learning on my own. I fell in love with it instantly. I was lucky enough to land an NGS scholarship in NUS. I am doing a PhD in Bayesian Inverse Problems and Machine Learning. I will be tearing my hair out for theories I cannot comprehend and losing sleep over a missing semi-colon I cannot find. You can taste the fun already.

**Q11 : Any advice for ESP students?**

For those interested in academia, take more mathematics. For those interested in industry, take more internships. For those who are uncertain, take more time. You will get there. Feel free to reach me on social media.

## Transfer of Tay Peng Yeow to Central Workshop

Our long serving ESP Laboratory Technologist staff, Mr Tay Peng Yeow, has been transferred to Central Workshop with effect from 2 January 2018. Mr Tay joined ESP as a Laboratory Technologist since the inception of ESP way back in December 2005. He has worked diligently to assist ESP students and staff in fabricating models and props for the design and research projects. His skillful technical skills and experience in building, repairing and strengthening structures, devices and machine have won the praises of ESP students and staff. He was awarded the Quality Service Achiever Award in 2011 for his outstanding and exemplary performance in delivering consistent and high quality administrative and engineering services to staff and students. ESP is pleased that his technical fabrication skills can be tapped by more engineering students and staff. ESP wishes him all the best in this new job which will certainly further enhance his technical skills.



## Plans and Career Paths of ESP Graduating Class 2017

	Graduate No	Specialisation	What are the 2017 graduates doing now ?
Higher Studies	1	CES	PhD with NGS Scholarship, expect to graduate in January 2022
	2	NANO	PhD with NUS-MSE for August 2017 intake
	3	NANO	PhD with ECE for August 2017 intake. Currently working as a Research
	4	PO	PhD with SUTD, expect to graduate in 2021
Professional Career	5	CES	1 year Management Programme with DBS Pte Ltd (SEED, Skill Enhancement Education and Development programme)
	6	CES	MIS Engineer - Software/Application with CTC Global Pte Ltd
	7	CES	Engineer with CSIT
	8	CES	Cyber Security Researcher with DSO
	9	CES	Programme Developer with DBS
	10	CES	Engineering & Scientific Officer @ DSO National Laboratories, Info Division, as a Member of Technical Staff (MTS)
	11	ES	Management Trainee with PCI Limited. Will be introduced to 4 different roles namely: account management, project management, demand planner and business development.
	12	ES	Technology Executive with DBS Pte Ltd (SEED, Skill Enhancement Education and Development programme)
	13	ES	Global Management Trainee with ISS Facility Services (SGP), Graduate in 18 months to a Key Account Manager
	14	ES	REC as a Process Development Engineer
	15	ES	Assistant Manager with CPF Board (Retirement Withdrawals Department)
	16	ES	Engineer with ST Electronics to develop software systems
	17	ES	System Engineer with Sopra Steria Asia
	18	ES	Network Solution Manager with Huawei International Pte Ltd
	19	ES	Engineer with TÜV SÜD Asia Pacific Pte Ltd
	20	NANO	Engineer with Yamaha Motor Co., Ltd. Iwata-city, Japan, Marine Engine Division
	21	PO	Researcher with MechanoBiological Institute (MBI), Singapore
	22	PO	Manufacturing Engineer at REC Solar Pte Ltd
	Entrepreneurial Career	23	CES

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