SUTD Honours And Research Programme (SHARP) Newsletter

Innovating Research with Design

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SINGAPORE UNIVERSITY OF
TECHNOLOGY AND DESIGN

ACTION-PACKED LIFE OF A SHARP STUDENT

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Class of 2022

Engineering Product Development (EPD)

You are in EPD pillar now, so what is a typical week like for you?

I would say my schedule varies from term to term, as it depends on the courses I am taking that particular term and their respective workloads and deadlines. In Term 5, I took *30.007 Engineering Design Innovation*, *30.101 Systems & Controls*, *30.102 Electromagnetics & Applications*, and *02.155TS Design Anthropology* (HASS). I was fortunate (or unfortunate) enough to have my lessons spaced out rather evenly across the entire week instead of being crammed into four days. Apart from Wednesdays and Fridays, I have lessons in the morning until about noon, a three-hour break, followed on by lessons in the afternoon. Breaks on Mondays are dedicated to HASS^ readings in preparation for lecture on Tuesday, while Wednesday afternoons are set aside for the SHARP-UROP research project before meeting my advisors on Thursday. I also spend Thursday nights and Friday afternoons working on my 30.007 project — a keyboard-and-glove system that trains new typists to develop proper keyboarding techniques, and to correct inefficient typing methods.

As I do not have a high-commitment fifth row, most of my free time outside of class is used to catch up on outstanding homework, course and research projects such as SHARP-UROP. On the other hand, weekends are for paying off the sleep deficit that I have accumulated over the past week, unwinding a little, and for finishing up as much 30.101 and 30.102 homework as possible before the start of a new week.

Of course, it should be noted that midterms, finals, and other events will throw a wrench in my schedule for that week, and I will spend the next week catching up on my work.

What are the perks of being in SHARP programme?

SHARP is a high commitment programme. While the cutting-edge topics covered during honours sessions were interesting in and of themselves, they were also theoretical and tough. The homework questions were challenging so I had to schedule weekly office hours with instructors to clarify my doubts. I developed better time management skills while in SHARP, given the need to complete homework and mini projects.

Looking back, I'm glad that I persevered and managed to stay in the programme, because there are still tacit benefits to being in SHARP.

First and foremost, the honours sessions did prepare me for the various research projects that I would go on to do, by imparting key research skills and attitudes applicable to all fields of study. One obvious example would be learning how to read long research articles, but perhaps a more salient one is the mentality that it is alright to be confused and lost, because being comfortable around uncertainty is part and parcel of research itself. Ultimately, research boils down to pushing the radical envelope of knowledge in a specific field, or the synthesis of ideas across different fields, some of which might not seem to intersect at first glance, i.e., a form of value creation. And that means unlike questions posed in conventional lessons where there are clear-cut right and wrong answers, questions posed in research might not even have answers to them yet, which is what you, as a researcher, want to find out.

Another thing I feel is that SHARP is a form of prestige and got me to places that I never thought was possible. It has allowed me to request an audience with busy professors who have never taught me before, who would otherwise ignore unsolicited student emails to discuss their own research. This actually came in pretty handy when I was looking for potential advisors for my undergraduate thesis, where a high-ranking Associate Professor recommended me to an even higher-ranking full Professor, who also happened to be the Director of one of the largest research centres at SUTD.

^ **HASS:** Humanities, Art and Social Sciences

Additionally, I found that faculty members tend to be more generous with providing high quality research opportunities when you are affiliated with a research programme backed by the University. Case-in-point: I worked with a faculty member in Term 1 on mentoring some Secondary School students on design thinking as part of a UROP that was open to all students, where I was introduced to design education research – a field that I didn't know existed until then – and got hooked. I mentioned to this faculty member that I was in SHARP and would like to immerse myself more into the world of research, and he straight-up offered me the opportunity to work with him on two out of a series of four papers on design pedagogy innovation. Tapping into my experience with computer aided design (CAD) software, I modelled the experimental set-ups used in those papers as diagrams and was fortunate enough to be included as co-authors on both these papers. [1, 2] In hindsight, I'm not sure if I would have gotten the paper publications in peer-reviewed journals had I just been a regular student doing an UROP.

Lastly, because it is compulsory to undertake a research project every term from Term 4 onwards as part of SHARP-UROP, I managed to work on different projects with different faculty members and learnt new skills in the process. For example, my Term 4 SHARP-UROP was a big data analytics project on optimising airport capacity utilisation, as part of a larger project to model of runway capacities according to the time of the day and weather conditions at Changi Airport. Through analysing delays and turnaround times of low-cost and legacy carriers at different terminals, I was able to pick up R programming language – something that is not taught in EPD, but rather in ESD*.

[1] Tan, S. Y.; **Chia, V. Y. Y.**; Hölttä-Otto, K.; Anariba, F. Teaching the Nernst Equation and Faradaic Current through the Use of a Designette: An Opportunity to Strengthen Key Electrochemical Concepts and Clarify Misconceptions. *J. Chem. Educ.*, **2020**, *97*(8), 2238–2243.

[2] **Chia, V. Y. Y.**; Hölttä-Otto, K.; Anariba, F. Using the Electrochemistry Designette to Visualize Students' Competence and Misconceptions on Electrochemical Principles. Singapore University of Technology and Design, Singapore. *J. Chem. Educ.* (Submitted for publication, 2021).

Other than SHARP, is there other involvement or activity that you are participating in?

Outside of SHARP, the bulk of my extra-curricular activities have been in mentoring students in design thinking, which I have been doing since my junior college days, and with good reason. In Secondary 4, I did a science project where I was taught design thinking by a very fierce teacher-in-charge (she called it "critical and inventive thinking"), and while I learnt a lot by the end of the project, I felt that my learning was mediated by a fear of punishment rather than an understanding of what I was doing. Because of that, mentoring has become a can-I-get-these-students-to-learn-as-much-as-I-did-without-resorting-to-the-fear-tactic exercise, about righting past wrongs, giving students the education that I wish I had gotten.

Prior to the pandemic, I had served on the technical expertise team and advisory committee for #startathon Junior for three consecutive years, where I advised upper secondary students on rapid prototyping and assisted them in 3D printing their prototypes during this 24-hour technopreneurship competition. I am also a facilitator at shorter design sprints, the most recent one being the SUTD-SST Big D Camp (the "D" stands for design) in January this year.

To date, I am mentoring Secondary 3 students from Raffles Institution on design thinking as part of the MOE Innovation Programme, together with the faculty member that I did the UROP with in Term 1. The collaboration has been a fruitful one every year since 2019, as the faculty member's strengths in ideation complement my application of what I learnt in EPD and my making use of the FabLab's^ resources to guide and assist these students with prototyping. We've introduced some advanced prototyping tools to these students too, from 3D printing to CAD to finite element analysis. To our surprise, the students enjoyed learning about these tools even though some of it probably flew over their heads.[3]

[3] Chia, V. Y. Y.; Yap, J. S. M.; Chan, H. H.; Peh, L. H.; Anariba, F. Applying Design Thinking to Bring Out Creativity in Raffles Institution Students: A Singapore University of Technology and Design & Raffles Institution Collaboration. Singapore University of Technology and Design. (Manuscript in preparation, 2021.)

* **ESD:** Engineering Systems and Design
^ **FabLab:** Fabrication Lab
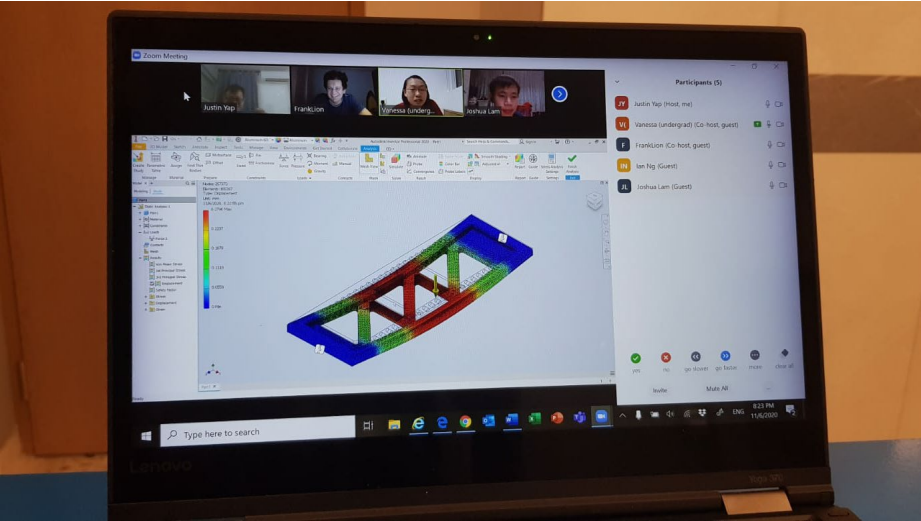
Teaching students how to conduct to conduct finite element analyses
and interpret the results in Autodesk Inventor Professional.
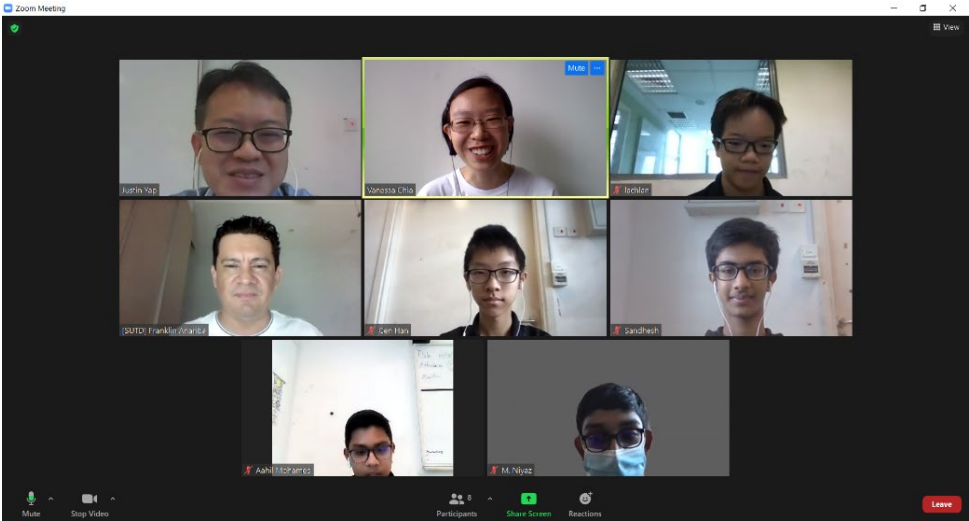
New batch of Raffles Institution students for MOE Innovation Programme 2021.

What research project are you working on, and what is the project about?

Starting from term 5, I am working on my undergraduate thesis on identifying prototyping competencies in design education (no surprises there), with an oral defense scheduled in Term 8. This adds value to the work of a current PhD student, Shravya, who is trying to come up with a standardised and comprehensive framework for educators to assess students in design thinking, which up till now has been subjective, differing from course to course, from instructor to instructor. Through a mixed methods approach, I aim to take both a holistic and reductionist lens in identifying the processes and factors at play in the complex concept of prototyping and break down these competencies into different levels of educational attainment, respectively.

I am being advised by Professor Lucienne Blessing at the SUTD-MIT International Design Centre, one of the pioneers in design education research, with my co-advisors Dr Franklin Anariba, the oft-mentioned faculty member in this interview, in charge of data collection, as well as Professor Carlye Lauff of University of Minnesota, who is an expert on prototyping. My advisors have been very helpful with clarifying any doubts I have, and our discussions are extremely insightful and always run into overtime as each person brings to the table a unique perspective from their own expertise.
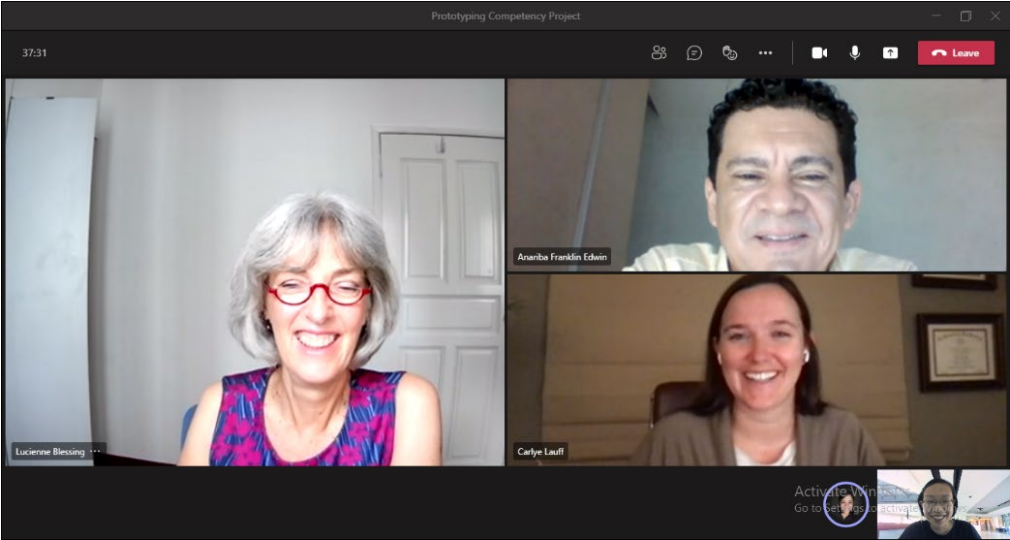
Having insightful meetings with advisors that always run into overtime.

I am in the literature review stage of my thesis, with data collection planned towards the end of the term, so to harken back to my response on the nature of research previously, I have absolutely no idea what the outcome of this project will be. But do ask me a year from now; I should be able to give you a more definitive answer.

SUTD VIRTUAL RESEARCH HACKATHON

Office of Admissions and SHARP Office organised the SUTD Virtual Research Hackathon on 10 and 11 June 2021. 39 students from Integrated Programme (IP) schools, Junior Colleges, Polytechnics and International Schools participated in this event over the two days. The mission of this hackathon is to understand and improve traffic conditions after accounting for probabilities in a world of random variables.

About this Hackathon

In this volatile and uncertain world, it can be hard to predict what will come next. Yet, there are some individuals, businesses and governments who may emerge as winners, as they are able to model and manage their risks and uncertainties.
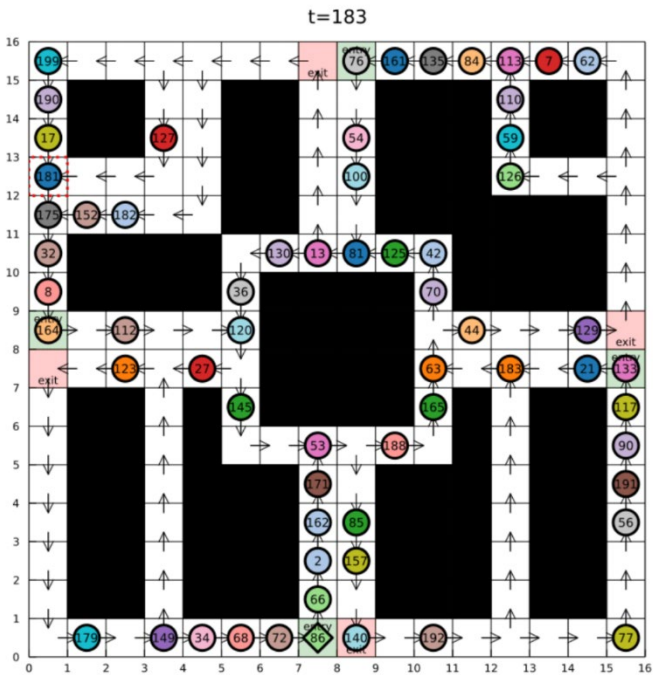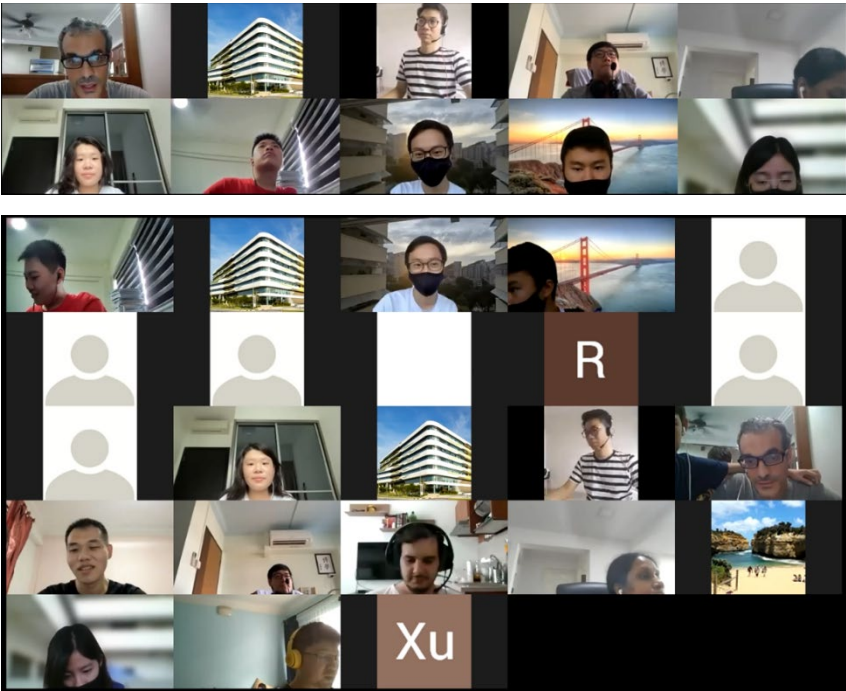
During the two-day online research hackathon, students got the opportunity to:

- be introduced to the Monte Carlo Simulation – a very powerful tool to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. It has applications in virtually every field, including finance, engineering, supply chain, and social sciences
- utilise the simulation to model traffic
- work in groups to propose and test different solutions to improve traffic conditions

Prof. Dario Poletti (SHARP Director), together with SMT postdocs, Dr. Vinitha Balachandran and Dr. Kee Chun Yun, and 10 mentors from SUTD helped and guided the students with the programming code using Julia in Jupyter notebook. Special thanks to the mentors in dedicating their time and effort for this hackathon!

The top 3 winning teams are:

- **Champion:** Nyx Iskandar (RI), Chua Yong Liang (RVHS), Wong Rayan (CJC), Rafi Afreen (ACJC)
- **1st runner-up:** Khornelius Hansen (SAJC), Lee Surjadi Jonathan Amadeus (SAJC), Kulruchakorn Napim (SAJC)
- **2nd runner-up:** Arvind Ajay (GIIS), Ramanathan Sagar (GIIS), Garg Ayush (GIIS), Drolia Palaksha (GIIS), Kaur Hargun (JPJC)

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