**James Dyson Foundation Undergraduate Bursary**

Supporting IIB projects in problem solving and design

As part of the application process for a James Dyson Foundation Undergraduate Bursary, students are required to complete all three parts of this application form and upload it using the online submission system. Completed application forms will be used by the Foundation to decide whether an award should be made.

**Part I: Applicant information**

Student name: Philip Salmony

Student CRSID (e.g. “ab123”): pms67

Supervisor's name: Dr. Fulvio Forni

Supervisor’s CRSID: ff286

Project code: F-FF286-2

Project title: Self-Balancing Bike

**Part II: Questions to applicants**

Each question should be answered in no more than 250 words unless otherwise stated.

* Why did you choose to study engineering at university?

*I was set on engineering for quite a while before I finally started the course at university. During most of my teenage years I would be making and building things after school and on weekends. For instance, amplifiers for my electric guitar, robots, and various other devices - mainly from scratch. One could say that my choice was influenced by the fact that my dad is also an engineer, so often we would undertake projects together and he taught me programming when I was about 10 years old. Putting all this together, it seemed to me that engineering would be the perfect subject to choose at univerity. And being in my final year now, I must say I don't regret it one bit. Engineering to me is as fascinating now as it was when I was younger and I'm looking forward to pursuing it and learning more for a very long time to come.*

* Where would you like to be in 10 years?

* What invention do you wish you had thought of?

*The jet engine. For me this is one of the greatest marvels of humanity. The amount of thought and effort that goes into the design and production of a jet engine is incredible. For instance, the fact that the turbine blades are operating at a temperature above their melting point, or that they are grown from a single crystal. It is amazing that with all the high pressures, high temperatures, thousands of different parts, and so on, modern jet engines are incredibly safe and enable millions of passengers per year to be flown across the whole world in just a couple of hours.*

* Who do you look up to?

* What advice would you give a young person considering engineering as a career?

*If you are set on engineering, take a fair amount of time to consider which engineering discipline you would like to pursue and actively seek out what you would be studying in that subject. Unfortunately, only a small amount of university courses worldwide offer a 'general' first year or two, where you can get a feel for different types of engineering areas. Luckily, Cambridge offers this which is a real plus. I originally applied to do Mechanical Engineering, but now I'm specialising in Electrical and Control - so for me that would've been a pretty bad choice!*

* Engineering is… (in one sentence)

*... taking relevant ideas from maths and physics, combining them, and producing something useful to solve a problem for society.*

* My hidden talent is…

*... playing the electric guitar. I've been playing in various bands (rock, big-band, etc.) both in Germany and the UK for about 10 years now. In particular, music from the 70s and 80s, such as bands like Queen, Van Halen, and Guns 'n' Roses.*

**Part III: Project information**

Please describe the proposed project, including (a) what the project will involve, (b) why you chose it (if relevant), (c) an indication of how the bursary would be used, and (d) an indication of what outreach materials will be produced (maximum 500 words). You are encouraged to add images to illustrate your ideas.

a) What will the project involve?

*The project involves the modelling, simulation, and control system design for an actuated, rider-less bicycle. Furthermore, a full-scale bicycyle will then be fitted with actuators, sensors, and a control unit, to test the theoretical work on a real-world, practical system.*

b) Why did I chose this project?

*Nearly everyone has ridden a bicycle once before in their lives and everyone eventually learns to ride it after a couple of tries. Additionally, we know that a rider-less bicycle is actually self-stable above a certain speed. However, people have not been entirely successful in giving a good explanation as to why that is. This poses several interesting questions, for example:*

* *How does a human stabilise a bicycle and can we replicate this behaviour with motors?*
* *What makes a bicycle more or less stable (such as changes in geometry, mass distributions, wheel size, etc.)?*
* *Would there be a benefit in having an 'assisted' bicycle for certain people and situations?*

*I therefore chose this project to try and answer - at least in part - some of these questions and because there are so many engineering aspects to it. From control system design, to mechanical implementation and to gaining understanding of how a bicycle stays self-stable. It is amazing how much feedback control is a part of most engineering discplines, from cruise control in cars, to flight control systems, and then to self-stabilising bikes. I feel that undertaking this project will greatly improve my understanding in a variety of subjects and finally: building and testing an actuated bike will be a whole load of fun!*

c) How would the bursary be used?

*The bursary would be mainly used to allow the development of a full-scale, actuated bicycle. This includes items such as motors, microcontrollers, sensors, 3D printing filament for smaller parts, and various other components. A bursary would also allow the development of an initial scale model, to test the control systems before moving on to a rather larger, full-scale version. It would be great to be able to do both and show that a full-scale 'autonomous' bicycle is possible.*

d) Which outreach materials will be produced?