R2T2 Newsletter

Welcome to R2T2!

It is almost five years since we first thought that a training programme in rocket propulsion could be an important part of securing the UK's return to space launch.

We had early and enthusiastic support from Diana Lunca, Kathie Bowden, and many more at UKSA and across the space ecosystem, for which we will always be grateful.

Our ambition has always been to include every university that wishes to participate in our programme, because rocket propulsion is an almost uniquely difficult skill to bootstrap: you are either doing it, or you are not!

Therefore, we are also grateful to the many university teams that have shared our vision, and of course to our first cohort of students who are now making the programme a reality.

Let me introduce our first six months of activity:

Our students have already met for training at Swagelok, and a group will soon be heading to Kongsberg alongside our partners from the Australian Rocket Systems Training Network. We have completed the build of our hotfire training facility at MachLab, with support from the Aerospace Systems Research Institute at the University of KwaZulu-Natal, and we are – of course – getting ready for our summer school at UK Race2Space next month. Alongside this, our students have been developing their relationships with our various industrial partners and shaping their own research trajectories.

Finally, we are already recruiting for our second cohort of students, so if you know anyone interested in a career in rocketry, please do put them in touch!

Patrick Harkness, Principal Investigator

R2T2 is funded by an award from the UKSA – Reference: ST/X006093/1

R2T2 News

Recruiting for Cohort-2 Studentships

We are now recruiting students to Cohort-2, with the projects scheduled to start in October 2025.

As with Cohort-1, each project includes a training package that will include small-bore tubing, propellant handling, first aid, and much more besides.

There will be annual opportunities to attend the Race2Space event and make partnerships with students from Australia, South Africa, and beyond.

Each student will also have the opportunity to help build and hotfire a biprop training engine, and each studentship comes with a consumables pot of around £50k to support the development of research engines or hardware in collaboration with an industrial partner.

Recruitment for the students is now underway.

Find out more at: https://www.r2t2.org.uk/cohort-2

Swagelok Training

In February, our Cohort-1 students attended small bore tubing training at Swagelok. Almost every conceivable liquid rocket system needs tubing, and learning how to design and assemble tubes, fittings, and components is a vital skill.

Our students now have their first formal qualification in building this vital hardware!

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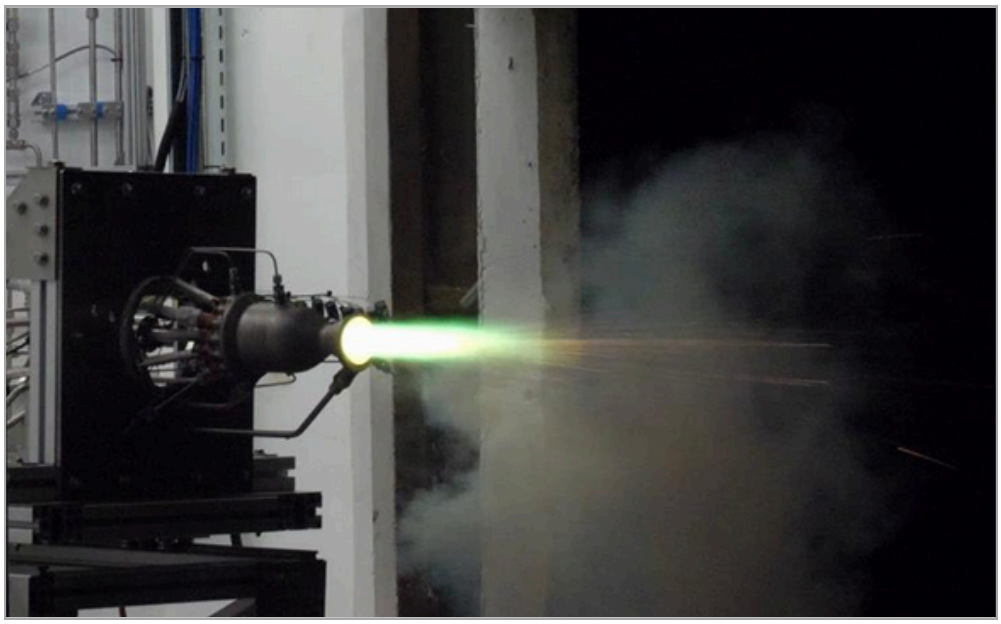
MachLab training facility

Designed by our technical and training lead, Krzysztof Bzdyk, and supported by Jack Tufft, Jack Davies, and many others, we have commissioned our cryogenic hotfire test facility. This will be the site of our students' introductory firings, as we demonstrate an existing engine in the months ahead, and it will then host some students' research hotfires as well.

At the introductory firings, our students will learn about safety, procedure, countdown, and how to make a feed system work: something that is perhaps more difficult than the engine itself.



Commissioning tests at the MachLab facility

Kongsberg visit

In June, five of our students will be going to visit Kongsberg as guests of our Australian partners. Norway was recently the site of the first orbital shot to be taken from continental Europe, and Kongsberg is a major centre of space technology in the country.

We are grateful to both ARSTN and Kongsberg for hosting us, and look forward to learning about the activities at the site alongside the Kongsberg Agenda, which is a major technology festival that will be taking place at the same time.

Summer School

In July, our students will be heading to our summer school. We have a training programme that will include pressurisation, propellant handling, and cleanroom skills; followed by a first aid course; guest lectures; and full access to the Race2Space symposium.

Students will make their first poster presentations, and meet with rocketry societies from across the UK. There will also be an opportunity to engage with industry, UKSA, and the wider ecosystem.

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Introducing our Cohort-1 Students

We have ten students in our first Cohort, working across nine different universities and starting at various times since October 2024.

Across this and the next four issues of the R2T2 Newsletter the students will introduce themselves and give some information on their area of research and why they wanted to be part of R2T2.

Maksymilian Augustyn - University of Southampton

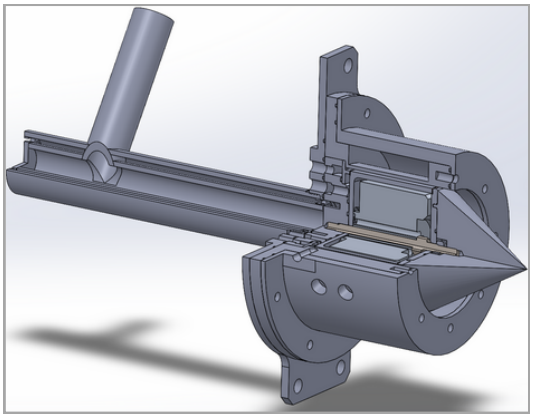
I'm from Poland, where I graduated from the Warsaw University of Technology.

For the past three years, I have worked as an R&D engineer at the Institute of Aviation in Warsaw on Rotating Detonation Engines (RDEs). My work has focused on liquid-propellant rocket and ramjet RDEs, encompassing both experimental work and CFD simulation.

Outside of work, I love spending time with my wife and children. I'm also an amateur yachtsman, an ultralight aircraft pilot, and an avid reader of literary classics and historical novels.

What attracted you to joining R2T2?

The possibility to research cutting-edge rocket propulsion technology, especially the opportunity to work on RDEs.



CAD design of a water-cooled Rotating Detonation Rocket Engine

What project are you working on?

My project aims to research loss mechanisms in the rocket Rotating Detonation Engines (RDE). I'll design and deploy a propellant delivery system and then set up the water-cooled RDE experiment in full. Different hydrocarbon fuels such as methane, propane and ethylene will be tested primarily with gaseous oxygen.

Corresponding three-dimensional simulations with in-house software AMROC will also be employed in this project to model the rotating detonation waves in the chamber and quantify the influence of non-idealities on combustion efficiency and engine performance, including injector performance, turbulent mixing, heat loss and in particular wall friction.

What has your progress been like so far?

I have prepared a full design and hardware assessment for the complete propellant delivery system and full set of data acquisition equipment.

I have also prepared a refined design of the RDE combustor that will be tested and is currently in manufacturing process.

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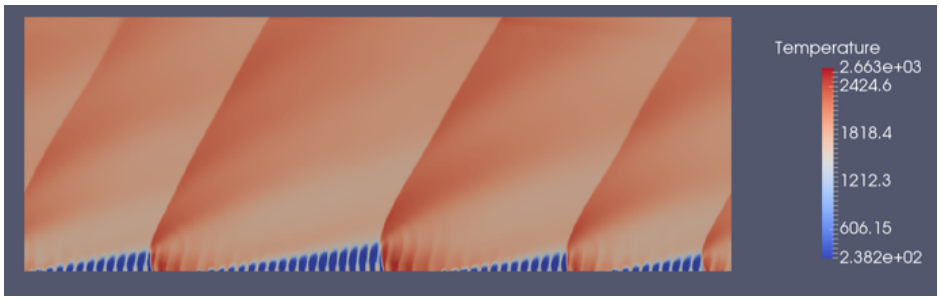
What will you be working on next?

Preliminary simulations on current chamber geometry setup.
Narrowing down research questions and looking for knowledge gaps.

Finalising fuel delivery system, data acquisition equipment and the rest of the lab hardware to be ready to run hot firings in the lab.



Flowfield of the 2D ('unwrapped') simulation of the Rotating Detonation Engines

Jack Cunningham - University of Bristol

I graduated from Swansea University in 2015 with a first class Masters in physics. Over the next nine years I worked as a scientist for QinetiQ in radio frequency electromagnetism research.

In my spare time I like hiking, climbing and reading.

What attracted you to joining R2T2?

I wanted something new, fresh and interesting to get stuck into and the R2T2 programme offered the opportunity to learn a vast number of skills in scientific/engineering disciplines I wasn't already specialised in.

What project are you working on?

My project is focused on the control of rockets and specifically how to perform landing manoeuvres with them. We want to look at both classical control of rockets and whether it's possible to apply reinforcement learning to this kind of platform. An important part of the project will be the creation of a realistic model. Increasing the realism of the model should make the transition from simulation to reality smoother.

What has your progress been like so far?

Rather than looking at a chemical propulsion rocket which allows for a one time launch I have been designing and building a coaxial copter with gimbal mounted propellers that should enable thrust vector control. The copter is more or less complete, although I'm sure I'll be able to find additional modifications as soon as we begin physical testing.

I have also created a model of the platform in Simulink and applied PID control to move the vehicle in three dimensional space. An added bonus was the ease of which the visualisation in Simulink now operates and actually looks very good because of it's use of unreal engine.

An electric motor rocket with gimballed propellers

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What support have you received from your industry partner so far?

I've recently met with the team at Airborne Engineering which also involved watching a hot fire test take place. They have supplied me with some reading matter on their hovering rocket "Gyroc" which I'm intending to translate into a Simulink model.

We're going to increase our communications to once a month and have suggested I have a secondment to their site in Aylesbury within the next 12 months in order to further my rocketry skills.

What will you be working on next?

Over the next three months I'll be looking at implementing some reinforcement learning control in Simulink. I will also be looking to build a test rig with a load cell, onto which I'll mount the gimballed propellers to get some real world force/moment data from the copter.

Eventually I'd like to take the PID control out into the real world and see if I can get this copter to hover and perform translations.

Join the growing network:

Are you interested in a PhD in rocket propulsion? Or perhaps you represent an organisation that would be interested in becoming an industrial partner?

We can provide the project opportunities, training, and test infrastructure you need to succeed.

Visit r2t2.org.uk to find out more

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R2T2

University Partners

Consortium Members

Cohort 1 - October 2024
Project Partners

Cohort 2 - October 2025
Project Partners

Visit **r2t2.org.uk** to find out more

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