

## **PhD Title**

Moving granular materials efficiently

Supervisors: [A/Prof Pierre Rognon](#), [Prof. David Airey](#) and [Dr Benjy Marks](#)

Institution: [SciGEM](#), [School of Civil Engineering](#), [The University of Sydney](#)

## **Synopsis**

Excavation of granular materials such as sands, gravels and fragmented rocks consumes a vast amount of CO<sub>2</sub> emitting energy worldwide. Energy losses arise when ground engaging tools move through the granular packing. However, the drivers and the magnitude of this dissipation remain poorly understood.

With this PhD, your role will be to determine excavation methods that minimise energy losses. You will conduct laboratory experiments involving a programmable robotic arm driving 3d printed buckets into granular packings. You will (i) experimentally identify how control parameters — e.g. bucket speed, size, depth, granular packing density — affect the dissipated power, (ii) develop mathematical models to capture, predict and understand their effect and (iii) use this new knowledge to find trajectories that minimize energy losses.

## **Research Environment**

With this PhD, you will join the Sydney Centre in Geomechanics and Mining Materials (SciGEM) at the School of Civil Engineering, The University of Sydney. SciGEM is leading research in applied granular physics internationally. It is a vibrant research environment with a tight-knit team of researchers: a dozen academics, several post-doctoral fellows and about 20 doctoral research students. You will directly benefit from their vast expertise in physics, geomechanics, geotechnical engineering, experimental methods and simulation techniques. You will also directly benefit from SciGEM's cutting edge experimental facilities.

## **Your role**

Under the guidance of your supervisors, you will be expected to:

- Design and conduct experiments
- Collect and analyse data
- Develop mathematical models of excavation energy losses
- Communicate your findings in domestic and international conferences, and via publication in scientific, peer-reviewed journals

## **Essential qualities**

This project is to be undertaken by someone who's:

- Passionate about it
- Willing to learn
- Able and willing to work in a team
- Naturally proactive and independent thinker
- Holding a Honours 1<sup>st</sup> class or equivalent degree in physics or engineering

## **Desirable skills:**

The project will involve the following skills. Your experience in any of them is desirable, your willingness to acquire them is essential:

- Applied physics and mechanics
- Laboratory experiments
- Motion control and data acquisition
- Coding using Python
- Writing using Latex

### **Scholarship**

The HDR scholarship is \$41,753 per year for three years. HDR candidates are encouraged to take on additional paid teaching activities (e.g. tutoring) which usually amount to an extra \$5k to \$10k per year

### **To apply**

Send your application by email at A/Prof. Pierre Rognon [pierre.rognon@sydney.edu.au](mailto:pierre.rognon@sydney.edu.au) including:

- Your CV
- Your transcripts (Honours and/or Master)
- A cover letter explaining:
  - what makes you want to work on this topic,
  - what make you a good fit for this topic,
  - a short research proposal (~half page) describing your vision of the research to be done.