Experimental characterisation of particulate flows

The design and operation of industrial processes is increasingly being optimised using computational modelling. However, computational modelling cannot capture the dynamics of both the macroscopic flow field and the motion of, e.g., individual particles within a reactor. Instead closure models are used to describe the physics that occurs at length scales below that which can be simulated. These closure models are typically developed from empirical observations. This research project will use advanced imaging techniques and detailed simulations of model systems to characterise particulate flows in more detail than has previously been possible. These new measurements will then be used to develop improved closure models that more accurately reflect the underlying physics. The student appointed to this position will be expected to work closely with our collaborators based at the University of Cambridge, UK and at Victoria University in Wellington.

Cheap, High Resolution Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is now the most common tool used in diagnostic medicine, and is increasingly being used in physics, chemistry and engineering. However, it is an expensive and impractical technique. Recently, companies such as Magritek in New Zealand have been pioneering new, relatively low cost MRI technologies. However, these instruments suffer from inhomogeneous magnetic fields and low signal strength making imaging with these systems challenging. This project seeks to develop new mathematical techniques to enable high resolution imaging using these cheaper instruments. The new techniques will be used to study a range of classical problems in chemical engineering, though will also have the potential to be applied in a wider context. The student appointed to this project will be expected to work closely with our collaborators in Wellington.