**A Robot that Swims Through Granular Materials**

*Dr John Royer and Dr Aidan Brown (both University of Edinburgh) together with Crover Ltd*

The Crover is the first small robotic device able to move within bulk grains. It is intended to use on-board sensors to scan cereal grains stored in silos and build a full map of conditions for early detection of infestations leading to grain spoilage. The robot (UK Patent No.2567898) works by using rotating parts to generate flow of the surrounding layer of granular particles that, unlike what would happen in non-granular systems, results in 'lift' forces that propel it through the ‘fluidised’ layer of granular medium (see video - <https://vimeo.com/crover>). The behaviour of the Crover strongly depends on local pressure and granular particle properties, so that efficient motion at depth and in different granular media types remains a challenge. Looking further ahead, the company wants to enable the robot to navigate different granular environments, such as sandy seabeds. Crover have therefore teamed up with John Royer and Aidan Brown at Edinburgh University to fully understand the fundamental physics of the Crover's interaction with the granular medium, and to take advantage of this to design the next generation of robots.

In this project you will focus on answering the question: What is the fundamental physics underlying the interaction of the Crover (or more generic propulsion mechanisms) with granular materials; how does this vary based on properties such as grain size or shape, the presence of moisture or of an interstitial fluid, e.g. in mud? This will involve systematically investigating the motion of the Crover or other test systems through small-scale lab 'silos' (a grain box in an environmentally controlled chamber), and gaining greater understanding through computer simulation and/or mathematical modelling. The project will involve an industrial placement at Crover Ltd. for 3-6 months, during which you will become fully immersed in the company. Through this project you will develop expertise in granular rheology and associated techniques, and will become part of the very active and multi-disciplinary Soft Matter and Biophysics research institute in Edinburgh Physics.