MONASH University Engineering

SIMPAS

Computational Mechanics Laboratory

# GRANICULAR SMOOTHED PARTICLE HYDRODYNAMICS (G-SPH)

We seek a highly motivated and quantitatively talented candidate to pursue a PhD project on numerical simulation of three dimensional (3D) liquid-solid flow using a novel Smoothed Particle Hydrodynamics method called Granicular SPH (G-SPH).

The aim of this project is to develop and apply a novel method to model solid-liquid flows that is based on the Smoothed Particle Hydrodynamics (SPH) method of Monaghan (2004, 2007, 2011). Instead of coupling SPH to a Discrete Element Method (DEM) technique, solid particles will be treated as SPH "super-particles" or "granicles" that are composed of multiple SPH particles. The approach is termed Granicular SPH (G-SPH) and preliminary unpublished simulations have shown that G-SPH results in qualitatively correct phenomena such as particle jamming and dilatation under shear. Obtaining good quantitative results will require adjustment of simulation parameters including appropriate equations of state for the granicles, granicle elasticity and, depending on the physical problem, other parameters that are yet to be defined.

This project offers an ideal opportunity for a numerically literate student to develop a new computational technique with clear and present application under the joint supervision of Prof. Murray Rudman and the inventor of the SPH method, Prof. Joe Monaghan. This project is supported by the ARC Industry Transformational Research Hub for *Computational Particle Technology* at Monash University, which involves 5 Australian and 5 International Universities (including the Laboratory for Simulation and Modelling of Particulate Systems, SIMPAS). It is part of a broader research engagement in which the student will work.

**The candidate**

The successful candidate will satisfy the following selection criteria at a high level:

**Essential Criteria**

1. Good mathematical background including ODE's, PDE's and numerical mathematics.
2. Some physics background and a good physical insight into real world problems.
3. Experience in developing numerical methods for solving equations.
4. A good understanding of fluid flow and continuum mechanics.
5. Some exposure and familiarity with Computational Fluid Dynamics
6. A demonstrated ability to program solutions to complex problems
7. Proof of English proficiency is essential.

**Desirable Criteria.**

8. Some exposure to Smoothed Particle Hydrodynamics an advantage (not essential)
9. Experience in with a high level programming language (e.g. Fortran, C, C++).

Interested candidates who clearly satisfy the above selection criteria at a ***high level*** should first contact Prof. Murray Rudman on murray.rudman@monash.edu for more detail of the application procedure. Candidates that satisfy the selection criteria above at only a moderate level, or satisfy only some of the conditions are encouraged not to apply, as the scholarship selection process is very rigorous.

***PLEASE SPECIFY THE PROJECT NAME "G-SPH" WHEN MAKING ENQUIRIES.***