Suspension Dynamics in Membrane Filtration

Purifying water is an increasingly important industry for society. Membrane filtration concerns the removal of particulate contaminants from water. A pressure-driven flow through a porous membrane may allow fluid to pass through, but not contaminants, producing clean potable water. However, the resulting accumulation of particles at the membrane surface is detrimental to the operation of the filtration process.

The hydrodynamics and physicochemical conditions of such a particle suspension leads to interesting yet critical features for modelling: boundary layers of high concentration, turbulent mixing, membrane pore blocking, poroelasticity, particle migration effects, and more.

This research project is flexible, though an emphasis on unsteady inertial effects is desired. Avenues for exploration include:

- Effect of shear flows and turbulent forces on deposition and adhesion
- Mitigation and control strategies
- Multiple particle species interacting
- Curved geometries and obstructions for enhanced mixing

A combination of mathematical and numerical modelling techniques are required. The candidate is expected to have a strong background in applied mathematics, in particular familiarity with fluid mechanics, differential equations, and scientific computing.

Introductory References:

- ☐ Guazzelli, E. and Morris, J.F., 2011. *A Physical Introduction to Suspension Dynamics* (Vol. 45). Cambridge University Press.
- ☐ Bowen, W.R. and Williams, P.M., 2001. Prediction of the rate of cross-flow ultrafiltration of colloids with concentration-dependent diffusion coefficient and viscosity—theory and experiment. *Chemical Engineering Science*, *56*(10), pp.3083-3099.
- ☐ Herterich, J.G., Griffiths, I.M., Vella, D. and Field, R.W., 2014. The effect of a concentration‐dependent viscosity on particle transport in a channel flow with porous walls. *AIChE Journal*, *60*(5), pp.1891-1904.
- ☐ Bacchin, P., 2017. An energy map model for colloid transport. *Chemical Engineering Science*, *158*, pp.208-215.