Boundary integral equations for two–dimensional low Reynolds number flow past a porous body

Wolfgang L. Wendland
Universität Stuttgart, Germany

In this lecture, we use the method of matched asymptotic expansions for the two-dimensional steady flow of a viscous incompressible fluid at low Reynolds number past a porous body of arbitrary shape. We assume that the flow inside the porous body is described by the Brinkman model, i.e., by the continuity and Brinkman equations, and that the velocity and boundary traction fields are weakly continuous across the interface between the fluid and porous media. By employing some indirect boundary integral representations, the inner problems are reduced to uniquely solvable systems of Fredholm integral equations of the second kind in some Sobolev or Hölder spaces, while the outer problems are solved by using the singularity method. It is shown that the force exerted by the exterior flow on the porous body admits an asymptotic expansion with respect to low Reynolds number, whose terms depend on the solutions of the above mentioned system of boundary integral equations.

By using the Oseen flow in the exterior, it can be shown that the Stokes–Brinkman expansion converges in any compact region to the Oseen–Brinkman solution if the Reynolds number tends to zero, in a similar manner as shown by G. C. Hsiao and R. C. MacCamy in 1973 and 1982 for flows around rigid obstacles.

The talk is based on joint work with M. Kohr and G. P. Raja Sekhar.

References

[1] M. Kohr, G. P. Raja Sekhar, W. L. Wendland, *Boundary integral equations for two–dimensional low Reynolds number flow past a porous body*, Math. Methods Appl. Sci. **31** (2008) 1065–1097.