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An Enhanced Immersed Structural Potential Method (ISPM) for the simulation of fluid-structure interaction problems

Antonio J. Gil

Zienkiewicz Centre for Computational Engineering (ZCCE), College of Engineering

e-mail: a.j.gil@swansea.ac.uk,
http://www.swan.ac.uk/staff/academic/engineering/gilantonio/

In this presentation, the Immersed Structural Potential Method (ISPM) will be presented along with a series of numerical enhancements. A key aspect of the success of immersed methodologies is the accurate description of the immersed structural domain. In the case of the ISPM, this relies upon the accurate spatial integration of the immersed structural potential and, crucial to this, is the quadrature rule employed as well as the number of integration points used. This aspect is analysed in detail for the case of the ISPM demonstrating that the number of integration points necessary to ensure accuracy of the scheme depends naturally on the selected kernel function. This will lead to the use of high-order quadrature rules, which can be efficiently utilised in conjunction with a new family of kernel functions, resulting in optimum results. Further results highlighting several qualities of the methodology will be presented (see Figure 1 left). Moreover, a Runge-Kutta Chebyshev Projection (RKCP-ISPM) time integration scheme will be introduced, leading to a very efficient fully parallelised framework that allows for the simulation of large-scale three-dimensional problems (see Figure 1 right).
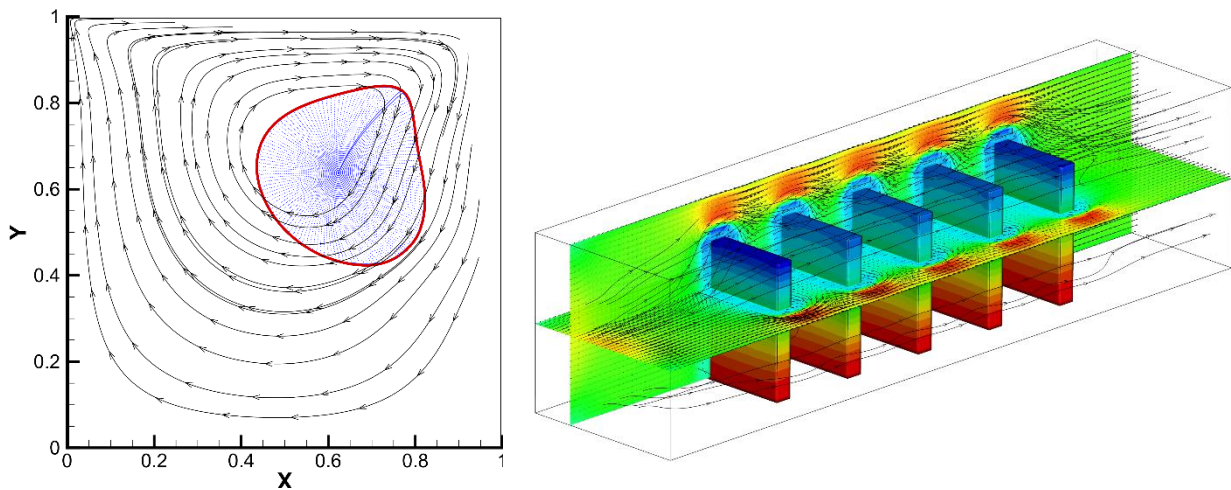
Figure 1: Left: Deformable cylinder in lid driven cavity flow. Right: array of elastic membranes interacting with a pulsatile flow.

REFERENCES

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