DOMINIQUE PELLETIER, Ecole Polytechnique de MOntreal
Implicit Runge-Kutta time integrators for flows on deforming domains

Implicit Runge-Kutta (IRK) schemes offer interesting numerical properties for the simulation of incompressible viscous flows on deforming domain such as free surface flows and fluid structure interaction problems. IRKs of all orders are both A-stable and L-stable. When used in conjunction with an appropriate, GCL compliant, ALE formulation they will maintain their fixed mesh high order temporal accuracy on deforming domains. For fluid-structure interaction problems, they simplify code development and maintenance since the same time-integrator can be used for both fluid and solid domains. Because IRKs have no intrinsic damping, they are ideally suited for for problems where the solid material has very small or no damping properties, and cases where a structure excited at low frequency elicit a response at high frequency. However, since all intermediate stages are fully coupled within a time-step, IRKs result in much larger systems of algebraic equations and thus can be very costly. The paper will discuss a fully coupled, monolithic formulation and present some applications.