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GRID DESIGN FOR THE COMPUTATION OF A HEXAGON-ROLL INTERACTION USING A FINITE ELEMENT METHOD. A. C. Skeldon,* K. A. Cliffe,† and D. S. Riley.‡ **Department of Mathematics, City University, Northampton Square, London, EC1V 0HB, England; †AEA Technology, B424.4 Harwell, Didcot, Oxon OX11 ORA, England; and ‡Theoretical Mechanics, University Park, Nottingham, NG7 2RD, England.*

Qualitatively incorrect bifurcation diagrams are computed unless the symmetries both of the solutions and of the underlying differential equation are properly accounted for. In the context of the computation of solutions to partial differential equations using the finite element method, this requires careful thought when designing a suitable computational domain and corresponding grid. Here we consider the problem of computing the interaction of hexagon and roll solutions bifurcating from a spatially uniform equilibrium solution of an E(2) equivariant partial differential equation. As an example of where such an interaction occurs we consider a partial differential equation describing the directional solidification of a dilute binary alloy. We show that if the symmetry is not taken into account then spurious disconnections can occur. We describe how to overcome this problem by constructing novel grids which have hexagonal symmetry and enough translational symmetry to enable the computation of the correct bifurcation structure.

A GENERALIZED PARTICLE SEARCH–LOCATE ALGORITHM FOR ARBITRARY GRIDS. Alejandro Allievi* and Rodolfo Bermejo.† **Martec Limited, 1888 Brunswick Street, Suite 400, Halifax, Nova Scotia, Canada B3J 3J8. †Departamento de Matemática Aplicada, Facultad de Ciencias Matemáticas, Universidad Complutense de Madrid, Madrid 28040, Spain*

A generalized iterative algorithm for searching and locating particles in arbitrary meshes is presented. The algorithm uses Newton method to invert a bijective map of the mesh elements onto a reference element, together with a criterion to move from element to element in the mesh. The generality of the method is shown by explicit formulations for linear and quadratic triangular and quadrilateral elements. Numerical examples demonstrate the performance of the method as well as its higher accuracy and versatility.

PRECONDITIONING TECHNIQUES FOR THE NEWTON–KRYLOV SOLUTION OF COMPRESSIBLE FLOWS. M. D. Tidriri. *Department of Mathematics, Iowa State University, Ames, Iowa 50011-2064.*

In this paper, we study an efficient strategy for constructing preconditioners for the Newton–Krylov matrix-free methods without forming explicitly the higher order matrix associated with each linear step in the Newton iteration. These preconditioners are formed instead using an explicit derivation of a lower order matrix similar to that associated with a defect-correction procedure. Comparisons of this methodology with the more standard defect-correction procedures, namely, the approximate factorization (AF) for structured grids and the ILU/GMRES for general grids, are then performed. To illustrate the performance of our approaches, we present some numerical applications to the steady solution of a two-dimensional Euler flow.

NUMERICAL ALGORITHMS FOR FLOWS IN THE NODES OF 2D MODELS OF PIPE NETWORKS. Vladimir Karlin. *The Robert Gordon University, Schoolhill, Aberdeen AB10 1FR, United Kingdom.*

This work is aimed at developing efficient computational algorithms for numerical simulation of steady-state incompressible viscous flows in nodes of circulation networks. High order accuracy implicit stabilization algorithms based on upwind finite-difference schemes were proposed. In order to treat complicated geometry, decomposition of computational domains was used. The effect of an external circulation network was simulated by means of nonlocal boundary conditions linking inlet and outlet flow parameters. A fluid flow related to specific cardiovascular operation was studied numerically as an example.

ON SPURIOUS FIXED POINTS OF RUNGE–KUTTA METHODS. F. Vadillo. *Departamento de Matematica Aplicada, Estadística e I. O., Facultad de Ciencias, Universidad del Pais Vasco, Apartado 644, 48080 Bilbao, Spain*

In this paper we investigate the onset of spurious fixed points when Runge–Kutta methods are applied to study the dynamics of differential equations. It is shown computationally that the spurious equilibria of Griffiths *et al.* [14] are connected at infinity with fixed points inherited from the differential equation. We introduce and study the concept of B-regularity which is in connection to the concept of regularity introduced by Iserles.

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