used in this sense to decompose the maximum memory working space required without affecting the results.

NUMERICAL MODELING OF ELECTROMAGNETIC CASTING PROCESSES. O. Besson, J. Bourgeois, P.-A. Chevalier, J. Rappaz, and R. Touzani, *Ecole Polytechnique Fédérale, Lausanne, SWITZERLAND.*

The main goal of this paper is to present a numerical model describing the major physical phenomena involved in electromagnetic casting industrial processes as precisely as possible. Under suitable physical assumptions, we derive the set of equations in the two-dimensional case; we describe in detail the numerical methods used to solve such equations and derive an iterative algorithm. Numerical results describing the case of an aluminium ingot are presented in order to show the efficiency of the method.

AN IMPROVEMENT OF FRACTIONAL-STEP METHODS FOR THE INCOMPRESSIBLE NAVIER–STOKES EQUATIONS. Hung Le and Parviz Moin, *Stanford University, Stanford, California, USA.*

A numerical method for computing three-dimensional, unsteady incompressible flows is presented. The method is a predictor–corrector technique combined with a fractional step method. Each time step is advanced in three sub-steps. The novel feature of the present scheme is that the Poisson equation for the pressure is solved only at the final sub-step resulting in substantial savings in computing time. It is shown that the method allows a larger CFL number and reduces the computing cost without loss of accuracy by satisfying the continuity equation only at the last sub-step. Numerical solutions for the decaying vortices and flow over a backward-facing step are obtained and compared with analytical and other numerical results.

NUMERICALLY INDUCED STOCHASTICITY. Alex Friedman, *Lawrence Livermore National Laboratory, Livermore, California, USA*; Steven P. Auerbach, *Science Applications International Corp., Emeryville, California, USA.*

The true motion of a particle in a one-dimensional potential well is regular, since conservation of energy constrains the velocity v at each value of the coordinate x. Nonetheless, when the orbit is computed numerically, stochastic behavior can result. We have considered simple integrators as *mappings* from (x, v) at one discrete time level to (x, v) at the next. In general, when the timestep size Δ is small enough, there are closed orbits, while for larger values there is chaos. Chaos can result for surprisingly small values of Δ in cases where the physical phase plane includes a separatrix. The behavior of the leapfrog mover as applied to motion in a particular double-well potential is examined in detail. Here, the onset of stochasticity occurs at step sizes much smaller than the stability threshold associated with the harmonic dependence of the potential at large $|x|$. Other one-dimensional wells and movers are also treated; implications of the area-preserving and energy conserving attributes possessed by some movers are discussed. A new variant of the standard map, displaying symmetry about both $x = 0$ and $v = 0$ in its phase plane, is introduced.

LONG-TIME BEHAVIOR OF NUMERICALLY COMPUTED ORBITS: SMALL AND INTERMEDIATE TIMESTEP ANALYSIS OF ONE-DIMENSIONAL SYSTEMS. Steven P. Auerbach, *Science Applications International Corporation, Emeryville, California, USA*; Alex Friedman, *Lawrence Livermore National Laboratory, Livermore, California, USA.*

The long-time behavior of numerically computed orbits in one-dimensional systems is studied by deriving a continuous-time "pseudo-dynamics" equivalent to the discrete-time numerical dynamics. The derivation applies to any numerical algorithm which conserves phase-space volume. A conservation law of the continuous-time system (conservation of the "pseudo-Hamiltonian") guarantees that the numerical