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Introduction

The original mission of the *Journal of Computational Physics* was to bring to the open literature the innovative work done on the first electronic computers during and shortly after World War II, primarily for solving very complex applied problems. One of the great visionaries in this field was John von Neumann, who pushed the development, not only of the electronic computer, but also of better algorithms, even before the war. He realized that the solution of the fluid dynamic equations for predicting weather would progress only through such efforts. Other early promoters included astronomers who predicted planetary motion and quantum mechanicians who worked on the Schroedinger equation. In the postwar period, as general-purpose computing equipment became available, there was an explosion in the development of computational fluid dynamics, radiation transport, and particle transport. Particularly noteworthy is the development of the Monte Carlo method for neutron transport, which would be unthinkable to carry out without a fast arithmetic machine and for which Fermi built a special-purpose gadget. The Monte Carlo method was subsequently extended to solve the many-body problem for realistic quantum and classical systems, one of the great advances uniquely attributable to the computer.

The initial thought on publishing this material was to start a book series in which each book would contain chapters authored by the originator of different numerical procedures in a given field, for example, hydrodynamics. After considerable thought, the name *Methods in Computational Physics* was chosen to establish that the field stood on its own intellectually, just as does theoretical physics. Indeed, the field is now often and properly described as a third approach in science, lying between experiment and theory. The idea was that the *Methods* series and subsequently the *Journal of Computational Physics* would be devoted to publishing innovative algorithmic developments in the solution of important physical problems, but only a typical example of the results would be displayed to validate the procedure. More extensive results would be published in existing publications devoted to that field. This underlying principle is as true today as it was then, because it is the methodology that is of common interest to those working both in the immediate field and in technically or mathematically related areas. This is also well illustrated by the articles that are reprinted herein from earlier issues; they are all concerned with pioneering algorithmic developments that have been widely used by others.

Publication of the *Methods* series commenced in 1963, but it soon became apparent that it was not adequate to meet publication needs, partly because of long delays in declassification of the material, because of the cumbersome delays in producing any multiauthored book, and in view of the rapidly expanding new research findings. Nevertheless, the *Methods* book series was continued for close to 20 volumes and was discontinued only when many of the special fields established their own journals or books. The *Journal* itself, launched in August 1966, rapidly became a success, showing that it filled a need.

Although the initial aims, to cover all fields of computational endeavors and to be international in character, are still valid today, it seems inevitable that any journal will attract only part of such a large field, in this case primarily computational fluid dynamics and plasma physics. The articles reprinted in this issue demonstrate the preponderance of papers in those fields. However, there are still major computational issues that have defied resolution and that I hope future issues of this journal will address. Among these issues are turbulence and the sign problem, that is, the numerical instability associated with the fermion many-body problem. It is these open problems that make the field so exciting.

It is also true that no amount of increased computer power that can be reasonably expected in the future is likely to resolve these issues by itself. They require clever algorithmic ideas. To be sure, computer power has increased phenomenally since the early days of World War II and is likely to continue to do so. Such progress is very welcome by workers in scientific computing, but that alone cannot overcome all the obstacles. Historically, algorithmic advances through improved numerical techniques have matched increases in computational speed in their effectiveness. Algorithmic advances are essential where no viable numerical technique exists as yet.

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