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Vectorising the Smooth Particle Hydrodynamics

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A new method to vectorise the SPH (smooth particle hydrodynamics) code is presented that makes the CPU time grow linearly with the number of particles. This method is presented in 2D, but can be easily extended to 3D, with only $\approx 20\%$ increase in memory. One of the main advantages of this hydrodynamical code is that a variable particle size can be used. This implies a variable spatial resolution, particularly useful to sample high density regions, in density-contrasted physical problems. © 1991 Academic Press, Inc.

1. INTRODUCTION

Most hydrodynamical problems require numerical calculations because of their complexity and some of them, such as astrophysical collapses, bring into play steep density gradients. It may be interesting to have at one's disposal a code with variable resolution. A lot of methods are proposed to simulate the fluid equations, but one of them (i.e., SPH method [5]) calls on the Lagrangian description of a fluid and has appreciable advantages.

Thanks to the development of vectorial and parallel computers with more and more memory available, the number of particles may be large enough and the resolution sufficient for a lot of problems. To optimize the computing time we propose a new scheme to carry out the vectorising of the SPH. Our scheme is machine-independent, in the sense that it optimizes automatically the vector sizes in the function of the machine characteristics. This allows us to benefit from the advantages of a Lagrangian description having a variable resolution (unlike the Eulerian one), without being penalized by the CPU time.

In the first section we present the numerical technique that will be compared with other schemes, while in the second section our new vector 2D-scheme performed on the VP200 will be described. We explain the smoothing kernel, artificial viscosity,

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