A New Kernel-Functions Family to Improve the Accuracy and Stability in SPH Simulations

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ABSTRACT

The SPH method has been extensively used in the last decades to simulate the fluid flow simulation. Based on Lagrangian formulation, in SPH the fluid is modelled by a set of particles, whose mutual interaction is formulated through a kernel function. By this formulation, they are obtained realistic simulations except when the fluid is subject to high changes of pressure, velocity and density in phenomena such as shock-tube, blast-wave, rarefaction-wave, turbulence or interaction with rigid boundary. In these situations, the accuracy and stability, of the obtained results, is compromised. In the last years, several research have related this inaccuracy and instability with the analytic features of the kernel function [1, 2]. In these research, have been set the features that any kernel function must satisfy to guarantee accuracy and stability. In this scope is located our research. We develop a methodology to obtain a new kernel functions family, based on harmonic functions. Essentially, the kernels are obtained from the convolution sine–cosine functions. Thus, the obtained kernel functions satisfy the constraints that guarantee accuracy and stability. Furthermore, a set of stability parameters are introduced what allow us to control the spurious behavior of particles. Thus, the accuracy and stability is maintained even on the flow regions, such as shock-wave or rarefaction tail, where the discontinuities appear. To evidence the obtained improvements a set of test simulations will be implemented. From these tests, we develop a comparison between the obtained results by our proposal and the kernel functions commonly used in SPH.

REFERENCES

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