

SOROBAN GRID FOR HIGHER ORDER SCHEME CIP

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The CIP[1-3] (Cubic-Interpolated Propagation / Constrained Interpolation Profile) is known as a universal solver for solid, liquid and gas and recently improved to guarantee mass conservation even in the framework of semi-Lagrange[4]. It does not need adaptive mesh system to describe the sharp surface motion and even the fluid-structure interaction. It has been proved to be useful for many research fields even in its original form, however, we meet some situation where mesh refinement is required to accurately capture boundary layer for example. For this purpose, adaptive mesh system had better be used. In adopting such adaptive system, we should not lose the accuracy of the scheme. Therefore we must find a new grid system that satisfies both adaptive capability and accuracy. We here propose a new mesh system called “soroban grid”. “Soroban” is the abacus used in oriental countries. In this instrument, balls with hole slide along the stem. The motion of the grid system resembles this instrument where balls correspond to the nodes of the mesh.

There are several merits of this system. (1) It is easy to generate the adaptive mesh. (2) Computational cost to generate it is very small and hence dynamical adaptation is possible. (3) The third-order accuracy of the scheme is kept if we use the CIP method and so on. The last item stems from the basic characteristics of the CIP method that it becomes third-order in a situation where at least one axis is along the straight line. The straight line corresponds to the stem in “soroban”. We applied this mesh system to several subjects including moving solid object, fluid-structure interaction in complex geometry.

References

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