Mass conservation in computational morphodynamics: uniform sediment and infinite availability

Mass conservation in computational morphodynamics: uniform sediment and infinite availability

Computational morphodynamics in finite volume methods are based on the evaluation of the rate of bed level change in the vertices on the deforming bed. With the use of finite volume methods on collocated (unstructured) grids, the rate of bed level change needs to be interpolated from the mesh faces to the vertices. First, this work reviews two methods based on a vectorial shape of the bed evolution equation (no scalar contributions from storage, erosion and deposition) in terms of their mass conserving properties. Second, a method that allows for scalar contributions in the bed evolution equation (the Exner equation) is proposed for general, unstructured meshes, and an analytical derivation for the simple one-dimensional problem on a non-equidistantly discretised grid is considered. The solution is compared with the general two-dimensional formulation. The two-dimensional formulation leads to the formulation of a geometric sand sliding routine on unstructured grids. The newly proposed interpolation method and the sand sliding routine are tested, and mass conservation of the sediment is considered with special emphasis on the effect of the solution accuracy for the suspended sediment transport. Discussions on other interpolation methods and their mass conserving properties are given with a special focus of the distance weighted interpolation method directly available and easily applied in Open FOAM. Furthermore, effects from horizontal displacements of the vertices, explicit filtering of the evolving bed and morphological acceleration on global mass conservation, are discussed. Copyright © 2015 John Wiley & Sons, Ltd.

General information
State: Published
Organisations: Department of Mechanical Engineering, Deltares
Contributors: Jacobsen, N. G.
Pages: 233-256
Publication date: 2015
Peer-reviewed: Yes

Publication information
Volume: 78
Issue number: 4
ISSN (Print): 0271-2091
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.2 SJR 1.183 SNIP 1.409
Web of Science (2017): Impact factor 1.673
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.371 SNIP 1.47
Web of Science (2016): Impact factor 1.652
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.69 SJR 1.101 SNIP 1.332
Web of Science (2015): Impact factor 1.447
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.85 SJR 0.999 SNIP 1.3
Web of Science (2014): Impact factor 1.244
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.66 SJR 0.748 SNIP 1.396
Web of Science (2013): Impact factor 1.329
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.58 SJR 0.936 SNIP 1.236
Web of Science (2012): Impact factor 1.352
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1