Coupling between DualSPHysics and SWASH models and latest applications to coastal engineering problems

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DualSPHysics model has been intensively used for studying free-surface flows and flow-structure interaction phenomena during the last years. DualSPHysics developers have been striven to widen the range of applicability of the code, by implementing multi-phase approaches, driven-object algorithms, splitting and coalescing techniques, wave generation and absorption techniques, OBCs, etc. Nevertheless, although millions or even billions of SPH particles can be simulated nowadays thanks to the computational power of Graphic Processing Units (GPUs), only one numerical model, whichever model, is not suitable to simulate multi-scaled, multi-phase and long-duration problems. In the field of coastal engineering the challenge is to model to whole process of wave propagation, transformation, wave breaking and wave-structure interaction.

DualSPHysics has been demonstrated to be very accurate to model cases of sea waves acting on coastal defences ([1]), however to model wave propagation and transformation over long domains and for long duration is not the most optimal field of application of DualSPHysics, whereas other numerical models, such as those based on NLSW equations (e.g. SWASH, XBeach), perform better and with reasonable computational cost. Therefore different algorithms have been explored and developed during the last years to couple DualSPHysics model with a wave propagation model, namely SWASH.

First coupling technique was proposed by [2], where the incident wave orbital velocities calculated in SWASH are passed to Moving Boundaries in DualSPHysics. Main drawback of this technique was the lack of any compensation method for wave reflection. Recently a Relaxation Zone method has been implemented [(3)], which overcomes the abovementioned limitation. An overview of these techniques and of the most recent applications to cases from coastal engineering will be presented at the workshop.

References:

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[2] C. Altomare, J.M. Domínguez, a J.C. Crespo, T. Suzuki, I. Caceres, M. Gómez-Gesteira, Hybridization of the Wave Propagation Model SWASH and the Meshfree Particle Method SPH for Real Coastal Applications, Coast. Eng. J., 57 (2015), 34 pages, 1550024. doi: 10.1142/S0578563415500242

[3] Usui, A., Domínguez, J.M., Suzuki, T., Altomare, C., Tagliafierro, B., 2017. Applicability of source generation (SG) and absorption technique in a highly reflective condition. 12th SPHERIC Workshop, 13-15 June 2017, Ourense, Spain.