

Lagrangian coupling two-phase flow model to simulate current-induced scour beneath marine pipelines

Abstract :

This paper presents a Lagrangian coupling two-phase flow model for simulating scour processes beneath a marine pipeline with respect to the sediment and fluid phase interactions. Smoothed Particle Hydrodynamics (SPH) capability is employed to simulate sediment and fluid particles movement, respectively as the Newtonian and non-Newtonian fluids in the framework of two-phase flow modeling. The Sub-Particle Scale (SPS) model also is closed to the fluid phase solver to account for the turbulence effects. The soft contact approach is incorporated in the sediment phase to simulate the interparticle collisions during the local scouring. Following to the Lagrangian coupling model development, the current-induced scour beneath a pipe at tunnel erosion and early stages of lee-wake erosion were explored and then compared with the experiments. The obtained results illustrated the efficiency of the proposed two-phase flow model to reproduce the scour profiles evolution up to the early stages of lee-wake erosion. Within the presented model, the parameters such as pressure field and non-dimensional sediment transport rate beneath the pipe were also estimated.