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A parallel multiscale DEM-VOF method for large-scale simulations of three-phase flows

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In this work, a parallelization strategy for a multiscale DEM-VOF method is investigated. This CFD-DEM coupling was recently used to approach several different engineering problems, ranging from process industry[1] to additive manufacturing[3]. Nevertheless, achieving good parallel performances is mandatory in order to address a wider range of engineering applications within a reasonable computational time [2].

In the multiscale DEM-VOF method, two different CFD grids are adopted, one for the coupling between the CFD and the DEM code and one for the solution of the fluid equations [1]. An interpolation strategy between the grids ensures the correct exchange of information between the bulk scale at which the inter-physics coupling is performed and the fluid fine scale at which the fluid equations are solved. In [1] the method was shown to produce grid-convergent results and to provide a higher accuracy if compared to a standard DEM-VOF method. Nevertheless, its enhanced complexity can represent an issue for its parallelization, that is needed to approach large-scale problems [2].

In this contribution, we investigate the parallel performance of the multiscale DEM-VOF method and compare it with a standard DEM-VOF coupling parallelized with an overlapping domain approach [4]. We show how the enhanced complexity of the multiscale method can be translated in an higher flexibility in the domain partitioning, and how this advantage allows it to address large-scale problems and scale over hundreds of processes.

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