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NUMERICAL MODELING OF FLUID STRUCTURE INTERACTION WITH MANY RIGID BODIES

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Abstract.

A methodology for the simulation of a large number of rigid bodies (RBs) colliding between them and with the walls, and interacting with a Newtonian fluid is presented. The RBs are simulated with the "prtclsys" C++ library, which represents RBs are a set of 4 or more particles with restrictions between them, and using quaternions for internal computations. The bilateral restrictions are taken into account via iterative penalization, whereas unilateral restrictions (e.g. collisions between the RBs themselves and with the walls) is computed via penalization. Interaction between the RBs and the fluid is computed via an embedded technique. The Approximate Nearest Neighbor Tree algoritm is used to determine if a given fluid cell belongs to a RB or not to compute the penalization terms, and hence the force on the RB. Regarding the structure, the prtclsys library allows simulating relatively complex arrays of rigid bodies, links, moors, contacts of the bodies with surfaces, and other restrictions. All items in the simulation are represented as particles, including the rigid bodies which are represented as arrays of four or more particles, arranged such that they have the same mass and inertia moments as the target body. The distances between the particles in the rigid body are fixed using restrictions, and the whole dynamics of the system is solved as a system of Differential-Algebraic Equations, using the trapezoidal rule integration scheme.