A leapfrog rotational algorithm using Rodrigues parameterization applied to DEM

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ABSTRACT

This work presents a leapfrog explicit integration algorithm for Discrete Element Method (DEM). Rotations are treated using a vector approach based on Euler-Rodrigues formula. The parameterization of Rodrigues is used to parameterize the rotations. In DEM problems, leapfrog schemes are preferred to integrate the movement. Respect to the rotations, a literature research shows that these schemes are, mostly, based on quaternions. A new algorithm is developed by the author, in which rotational leapfrog explicit integration does not use quaternions. Instead, it is proposed a vector approach based on Rodrigues parameters. The main algorithm consists in updating the rotational tensor to obtain the orientation of the particles. In our approach, the orientation of a particle is stored using the three parameters of the Rodrigues’ rotation vector. The rotations are executed using an expression that provides an exact result for composed rotations in 3D space. In our examples, superellipsoid particles are used. Detailed aspects about the proposed rotation scheme are discussed and solved.

REFERENCES


