Energetic Consistency Conditions for Perfect Collisions

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ABSTRACT

Collisions have to satisfy three compatibility conditions, which are kinetic, kinematic and energetic consistency. While the first two are unquestionable and easily derived from kinetics and kinematics of the underlying Lagrangian system, the third is much more subtle concerning its pysical implications and the mathematical conclusions that can be drawn from it. In the talk, we address in particular the question of energetic consistency for perfect collisions by discussing four different classes of impact configurations. These are impacts under scleronomic inequality constraints, impacts under linearly independent rheonomic constraints, impacts under general rheonomic inequality constraints, and finally impacts with additional impulsive forcing. We will see that the classical energy ball characterizes energetic consistency for the first two classes, but has to be replaced by a lense-shaped object for the third class. For the fourth class, we give examples why the understanding of an impulsive force characterized by its direction and magnitude is no longer meaningful when the energetic consistency problem is addressed.