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Analysis of impact dynamics by use of the regularized model approach

In recent years there has been a significant increase in modeling systems characterized by unilateral constraints, impacts and impulsive control actions. This increase is motivated by numerous applications. In order to get responses that are very close to what experiments show several approaches working with an ideal rigid-body model before and after impact are developed. This is because the rigidity assumption causes problems connected with existence and uniqueness of solutions, as well as with energy balance laws. We have in mind the general oblique and rough impact [1], the colinear impact of three spheres [2], and the Painleve problem [3]. By use of so-called regularized models in which the contact area is substituted by a massless spring-damper element, the response of the system during impact interval is computed by solving the corresponding differential equations [4]. In order to regularize problems in both mathematical and thermodynamical point of view, instead of massless spring-damper elements one can use the constitutive equations of viscoelastic body that comprises fractional derivatives of stress and strain and the restrictions on the coefficients that follow from Clausius-Duhem inequality [5]. We shall show how the collision of a point and a fixed plane, the colinear impact of three spheres, and the Painleve problem can be regularized in such way.

References

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