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A consistent viscoelastic formulation for the numerical analysis of steady state rolling tires

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Abstract

The analysis of rolling rubber wheels under stationary conditions is commonly done using an Arbitrary Lagrangian-Eulerian formulation, especially suitable for finite element analysis under consideration of elastic or hyperelastic materials. While the reference frame is neither attached to the material, nor fixed in space, all equations can be expressed independent of time. However, this leads to the challenging task of taking internal variables into account for inelastic materials. In this contribution, a coupled approach for the analysis of steady state rolling bodies with inelastic properties is presented. A subsequent viscoelastic formulation takes into account the inelastic contribution of all material points along a streamline. Furthermore, coupling terms are obtained, which have to be considered in the system of equations. The reliability and application of this formulation to tire analysis is discussed and important remarks close this presentation.

Keywords: A. Dynamics, B. Viscoelastic material, C. Finite elements, steady state rolling

1. Introduction

The analysis of rolling rubber wheels is of large interest in industry, especially due to its direct application to the design and study of tires and rollers. The

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