 ICCES, vol.16, no.1, pp.15-15

Verification and Analysis of Transient Hydroplaning Performance for inflated Radial Tire with V-shaped Groove Tread Pattern on the Fluid Structure Interaction Scheme

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Summary

Current work studies the transient hydroplaning behaviors of 200 kPa inflated pneumatic radial tires with V-shaped grooved tread patterns and then rolls over the water film with a thickness of 10 mm. we also perform complete numerical simulations in order to know how to elevate the hydroplaning capability. Tires were numerically loaded with a quarter car weight of 4 kN on initial step, and then subsequently accelerated from rest rolling over a water film with a thickness of 10 mm on top of a flat roadway. Tire structure is composed of outer rubber tread and inner fiber reinforcing composite layers. Besides, present work was adopted the simplified model for reinforcing composite layers that were using Belytschko-Tsay shell element to construct (1). The Mooney-Rivlin constitutive law and the classical laminated theory (CLT) were, respectively, used to depict the mechanical behavior of rubber material and composite reinforcing layers. The tire hydroplaning phenomenon was analyzed and simulated using explicit finite element code - LS-DYNA. The Arbitrary Lagrangian & Eulerian (ALE) and Eulerian formulations were completely performed the fluid-structure interaction (FSI) behavior in this study. The normal/reverse rotations of the V-shaped tread pattern were discussed and presented in order to observe the difference for elevating hydroplaning capability in this study. Besides, simulated dynamic normal contact force and hydroplaning velocity of tire with a prescribed smooth tread pattern were obtained. The computed results were in good agreement with the numerical and test results given by Okano, et al. (2001) for tire running over 10 mm thick water fluid film. Notice that single material and void (SMV) and multi-material combinations were also utilized to describe the fluid film in this verified simulation.