AN EFFICIENT MODEL FOR SIMULATING ROLLING CONTACT BETWEEN TIRE AND GROUND DURING SIDESLIP

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Both the handling and wear performance of tires are very much dependent on sideslip behavior. Of particular interest to tire design engineers, are the lateral force and self-aligning moment properties and the tire contact patch pressure distribution. Typically, detailed nonlinear finite models, which involve large number of DOF, are used to model the stress behavior of tires. These models require large amounts of computer time to simulate a rolling tire, thereby reducing the number design alternative that can be evaluated. Another approach is to use a component model to reduce the number of effective DOF [1]. In this approach, the tire structural mode is composed of shell elements that describe the tread deformation, coupled to special purpose finite elements that describe the sidewall deformation. The special purpose element uses a pre-computed look-up table to efficiently calculate the sidewall shape, and the forces (and moments) at spindle and tread interfaces [2]. An Arbitrary Lagrangean Eulerian (ALE) approach is used to model both steady-state, and non-steady-state, tire rolling [3]. This model is designed to predict the forces at the spindle and tire/ground interface, as opposed to the internal stress fields. The resulting simulation is both efficient and robust, and has demonstrated good agreement with experiments [1,2].

This presentation focuses on the problem of modeling rolling contact between a treaded tire and ground in an efficient manner. A two-step approach for modeling contact between the tire and ground is being proposed. Contact parameters, first generated by a tread block/ground simulation, are mapped onto the component tire contact model. The later model is used to generate spindle lateral force, self-aligning moment, and tire contact pressure distribution responses for a tire rolling with prescribed slide slip angles. The impact of tread model boundary conditions, mesh density, and tire tread pitch sequence on spindle force and moment response is addressed in the presentation.

References

[1] I.M. Darnell, G.M. Hulbert, and C.W. Mousseau,"An efficient three-dimensional tire model for vehicle dynamics simulations," *Journal of Mechanics of Structures and Machines*, v. 25,p. 1-19, 1997.

[2] I.M. Darnell, C.W. Mousseau, and G.M. Hulbert,"Analysis of tire force and moment response during sideslip using an efficient finite element model," *Journal of Tire Science and Technology*, v. 30,p. 64-82, 2002.

[3] I.M. Darnell, C.W. Mousseau, and G.M. Hulbert,"An efficient rolling contact model," In preparation.