Fact Sheet

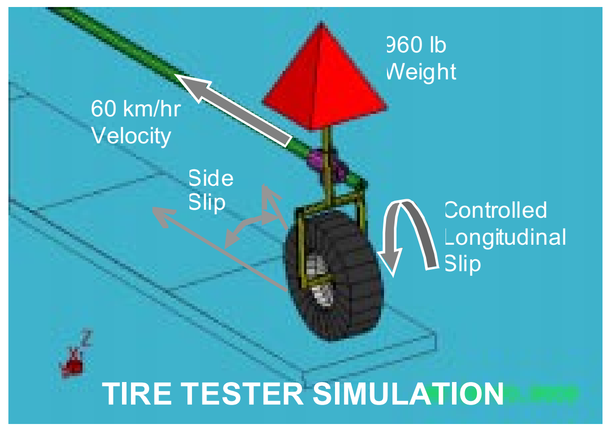
On-Road Tire Model for 3-D Dynamic Vehicle Simulations

PROBLEM

Accurately represent tire/road interactions in high-resolution computer simulations of wheeled vehicles maneuvering on dry, wet, ice-covered, and snow-covered, road surfaces.

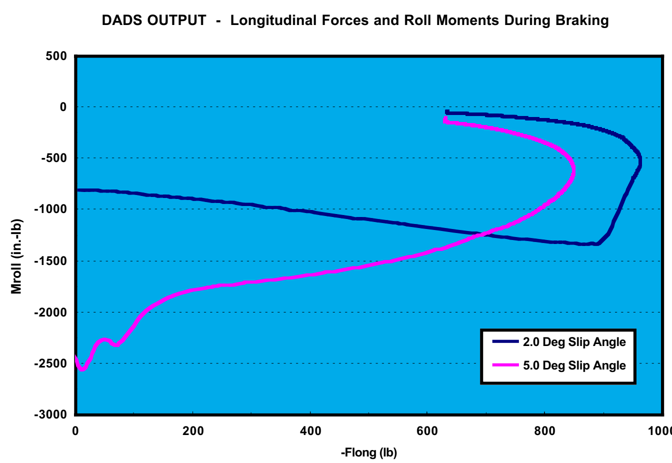
SOLUTION

On-road vehicle mobility is important to the military, as it is a major factor governing the movement of troops and materiel in the field. Accurate representations of wheeled vehicle maneuvering capabilities (traction, braking, and cornering) are needed via high-resolution dynamic models to predict maximum over-the-road vehicle speeds as road surface conditions worsen because of degraded weather. A critical element in any wheeled vehicle dynamic model is the algorithm that defines the interaction between tire and road. Current tire models are either physically inaccurate or impractical to use. An alternative analytical model has been developed to predict tire forces and moments at the tire/road interface. The model is computationally efficient and requires only a limited set of easily obtained tire input parameters.



RESULTS

The On-Road Tire Model calculates longitudinal and lateral forces along the contact patch of a tire rolling on a road surface. It represents these forces as an equivalent set of orthogonal force and moment vectors at the point of intersection of the tire and road surface planes. Tire model force and moment calculations are based on mechanical analogs that describe vertical, longitudinal, and lateral tire tread and sidewall deflections during braking, traction, and cornering. Vertical (i.e., normal to the road surface) deflections and forces are calculated using an existing distributed contact algorithm. Longitudinal deflections are determined using a simple linear elastic spring model, while lateral deflections are calculated using an innovative approach based on elastic beam theory. Operating variables that determine tire patch longitudinal and lateral forces and roll and aligning moments are tire normal force, longitudinal velocity, lateral velocity (or side slip) and longitudinal slip (i.e., degree of braking or traction). Source code has been developed to incorporate the tire model into commercially available dynamic analysis software known as DADS (Dynamic Analysis Design System). The tire model has been successfully demonstrated within a DADS simulation of a simple tire test device (see figures). Preliminary comparisons of tire model predictions with available test data have been favorable. Future activities include incorporating the tire model into a DADS model of a HMMWV and conducting driving simulations on dry and snow- and ice-covered road surfaces.



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October 2000

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