



Off-road tyre modelling I: the multi-spoke tyre model modified to include the effect of straight lugs[☆]

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Abstract

The study of off-road vehicle tyre–terrain interaction is of great interest in establishing functional relationships that can realistically describe the forces generated between the soil and tyre and the forces generated in the tyre structure. As a result of wheel–terrain interaction, normal and shear stresses develop at the interface, giving rise to tyre forces and moments. The multi-spoke tyre model was modified to study the interaction between a tyre with straight lugs and the terrain. Predicted results for steady state conditions and the case of combined lateral and longitudinal slip for a rolling tyre were derived. A computer program using MATLAB software was developed, and the results were shown in the form of tyre forces and moments in the three directions summed over the tyre contact length. A comparison between the effect of a smooth tyre and a tyre with straight lugs on tyre forces and moments was presented. The effect of many parameters such as slip angle, soil deformation modulus, lug dimensions and lugs spacing on tyre forces and moments was discussed. The results showed that the tyre with straight lugs can develop higher tractive and lateral forces than the smooth tyre. The slip angle and soil deformation modulus have a significant effect on off-road tyre performance. Tyre forces and moments decline with the increase of both the lug height and ratio of total area of lug/total area of tread. © 1999 ISTVS. All rights reserved.

Keywords: Off-road vehicle performance; Tyre forces; Tyre modelling; Lugs

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