

Modeling and Sensitivity Analysis of Anti-Roll Hydraulic Interconnected Suspension for Tri-Axle Mining Dump Trucks

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INTRODUCTION

Suspension system is an important part of a vehicle, which is related to ride comfort and handling stability. Due to harsh working environment, the tri-axle mining dump truck puts higher requirements on suspension system. The hydraulic interconnected suspension (HIS) system can realize the decoupling of vehicle motion modes and coordinate ride comfort and stability. Compared with active suspension, HIS is more suitable for mining vehicles due to simplicity, reliability, and no need for energy.

The structural parameters of HIS will affect the working performance of suspension, and their influence degrees are different. Therefore, it is very important to study the parameters sensitivity to suspension performance. At present, The researches mainly focus on two-axle vehicles, and the researches on tri-axle vehicles are few. Therefore, this paper takes an anti-roll HIS for tri-axle mining dump truck as research object, and the influence of parameters on performance is analyzed by Morris method.

RESULTS

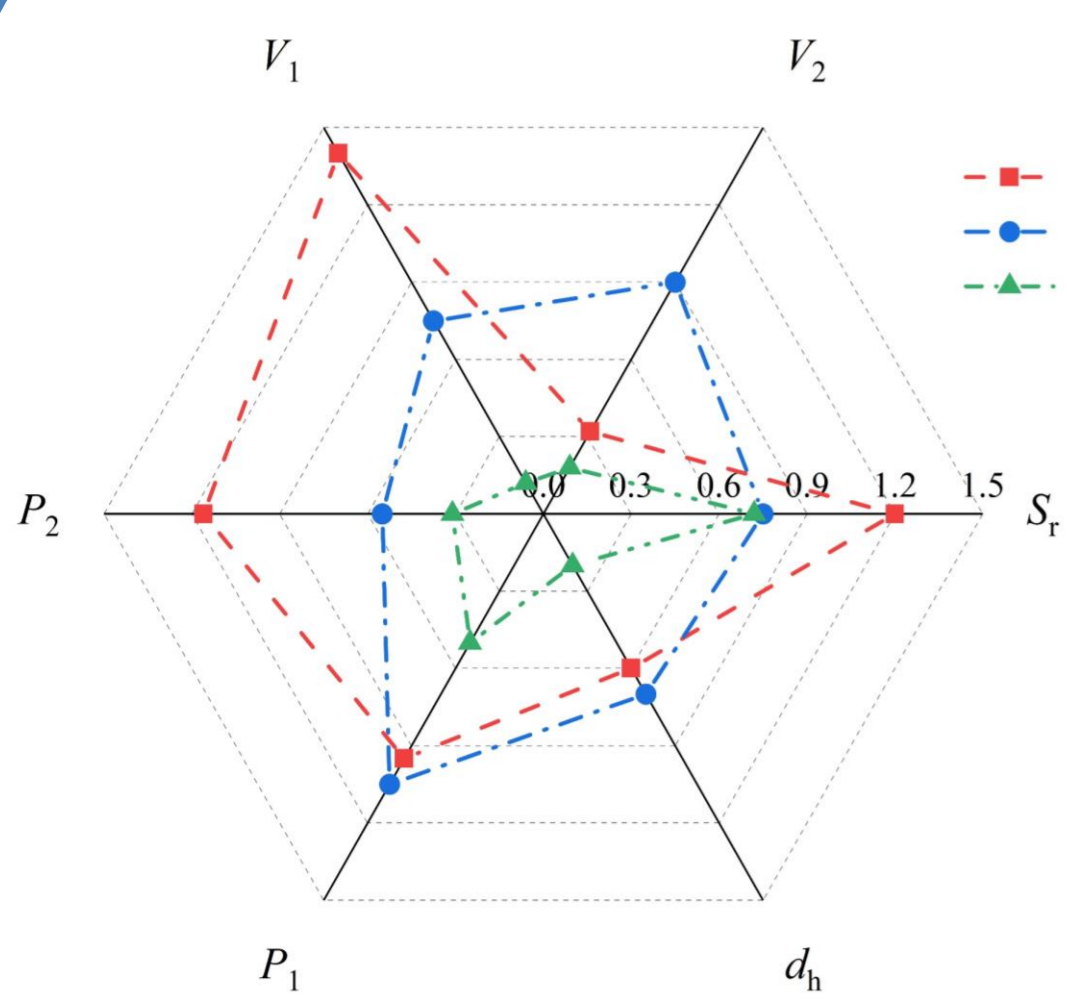


Figure 3. Sensitivity factor of structural parameters

The selected structural parameters include the ratio of upper and lower chamber area of cylinder S_r , the diameter of damping hole d_h , the initial inflation pressure and volume of front accumulator V_1 and P_2 , the initial inflation pressure and volume of mid-rear accumulators P_2 and V_2 .

CONCLUSION

The sensitivity factors of structural parameters in bounce and roll modes are higher than that in pitch modes, which means that bounce and roll modes are easily affected by structural parameters. The pitch mode is not sensitive to the change of parameters, because the wheelbase of tri-axle mining dump truck is longer and the pitch angle of vehicle is smaller. In order to improve the anti-roll ability and ride comfort, attention should be paid to the initial volume of front accumulator and the ratio of upper and lower area of cylinder, which are more sensitive in the bounce and pitch modes.

METHOD

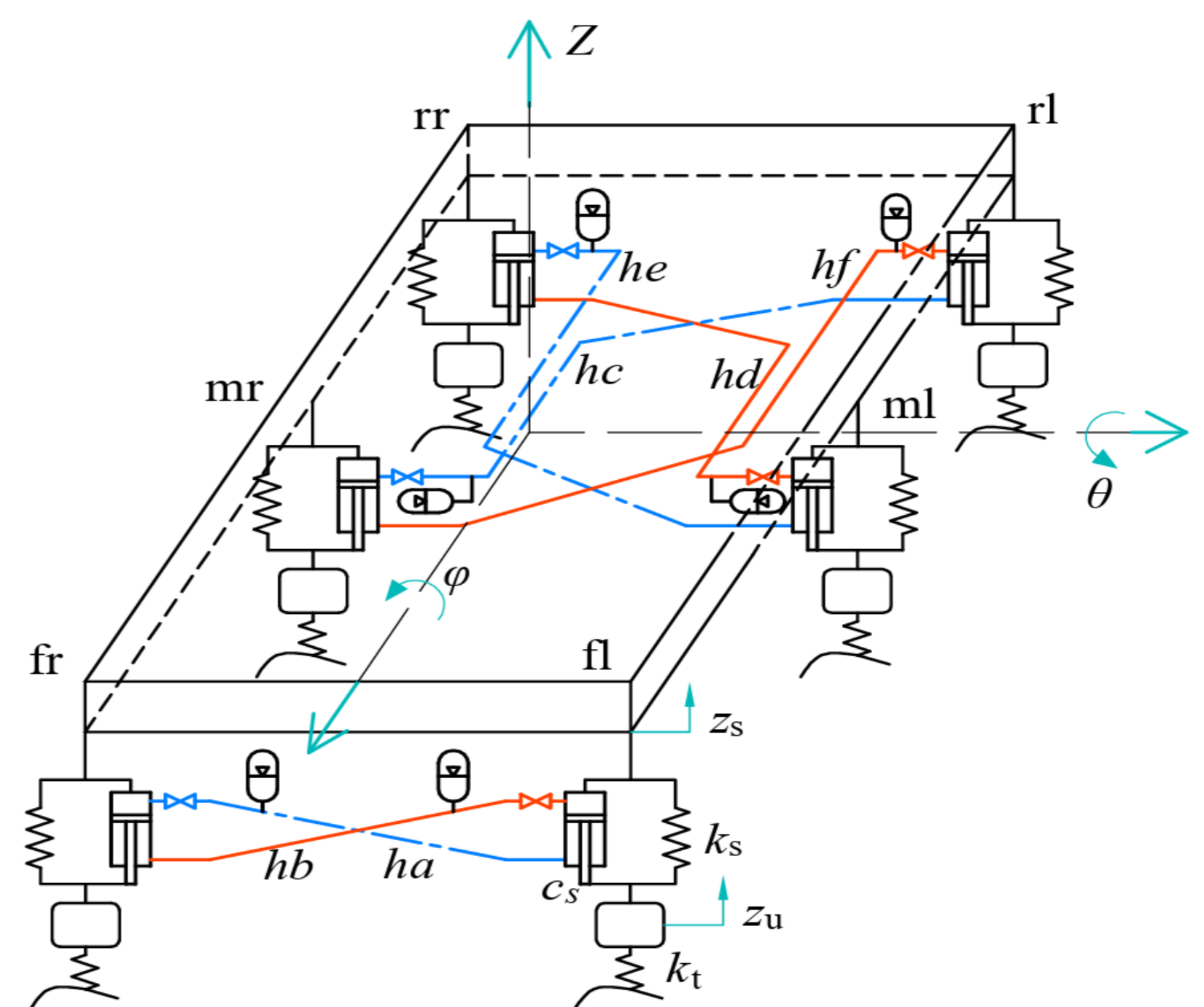


Figure 1. Nine-DOF dynamic model of whole vehicle

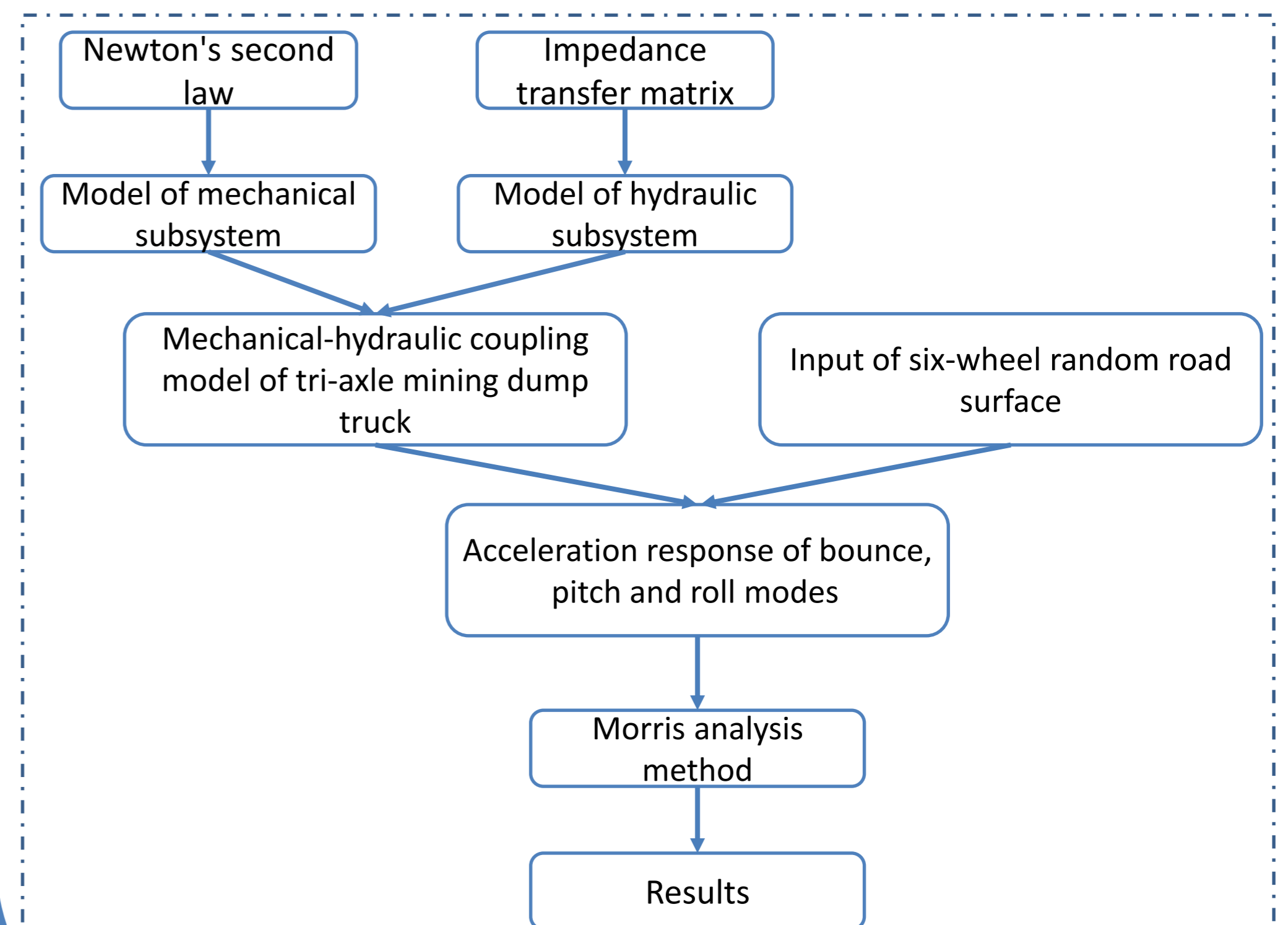


Figure 2. Modeling and analysis flow chart

REFERENCES

1. Wang, M.; Zhang, B.J.; Chen, Y.C.; Zhang, N.; Zhang, J. Frequency-Based Modeling of a Vehicle Fitted with Roll-Plane Hydraulically Interconnected Suspension for Ride Comfort and Experimental Validation. *IEEE Access*. 2020, 8, 1091-1104.
2. Zhang, J.; Deng, Y.W.; Zhang, N.; Zhang, B.J.; Qi, H.M.; Zheng, M.Y. Vibration Performance Analysis of a Mining Vehicle with Bounce and Pitch Tuned Hydraulically Interconnected Suspension. *Chin. J. Mech. Eng.* 2019, 32, 17.
3. Wu, X.J.; Qiu, X.; Zhou, B.; Huang, J.H.; Zhang, T.F. HIS-Based Semiactive Suspension Dual-Frequency-Range Switching Control to Improve Ride Comfort and Antiroll Performance. *Shock Vib.* 2019, 2019, 16.
4. Chen, S.Z.; Zhang, B.J.; Li, B.Y.; Zhang, N. Dynamic Characteristics Analysis of Vehicle Incorporating Hydraulically Interconnected Suspension System with Dual Accumulators. *Shock Vib.* 2018, 2018, 15.