Application of metamorphic theory in vehicle shift dynamics

Abstract

The present researches of vehicle shift dynamics are mutually independent and essentially qualitative. It is quite difficult to characterize the dynamics behaviors of vehicle transmission shift systematically, integrally and quantitatively. Vehicle power train is one kind of the generalized metamorphic mechanism. Therefore, it is necessary to pursue the study of vehicle shift dynamics to break through the limit of the present research contents and modeling methods based on the metamorphic theory.

Method

Metamorphic theory interpret how the topological structure and mechanism freedom change with the boundary conditions variation. The essence of the vehicle shift is the transformation from one kind of stable state to another according to the variation of the transmission parts, constraints, and power transmission route etc. This process behaves the characteristics of multi-function stage transformation, multi-freedom variation, multi topological mechanism. Therefore, vehicle shift process conforms to the metamorphic mechanism theory. The study of vehicle shift dynamics based on the metamorphic theory can be decomposed as following. Firstly, the power train is gradually disassembled to hierarchical models. Secondly, metamorphic route and metamorphic form of each vehicle shift are mathematically presented. And the nonlinear mechanism models of gear pair and wet clutch are both established. Thirdly, the metamorphic function and metamorphic matrix of vehicle shift are established based on the set theory and screw theory.

Conclusion

Vehicle power train is one kind of the generalized metamorphic mechanism. Vehicle shift dynamics is equivalent to the problems of the topological representation, metamorphic principle analysis, and metamorphic equation establishment and solution. This research offers the theory and technology support for the study of shift optimization, dynamic strength design and vehicle comfort.

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Conflicts of interest

The authors declare there is no conflict of interests.

References

