講演番号	220

文献番号	20225220

An Enhancement of Development Process of Fuel Efficiency and Torsional NV using Transmission VRS

Hiroki Kuwamoto [1)] Takeshi Kitahata [1)] Takeshi Ishiwada [1)] MasayoshiOta [1)]

Hirokazu Kurihara [1)] Hiroaki Sumitomo [1)]

1) Toyota Motor Corporation, 1 Toyota-Cho, Toyota, Aichi 471-8571, Japan (E-mail:hiroki_kuwamoto@mail.toyota.co.jp)

KEY WORDS: Noise, Powertrain, Evaluation, VRS (B2)

Enhanced fuel economy is required on HEV (Hybrid Electric Vehicle) powertrain to pursuit the Carbon neutral. Torsional NV, such as transmission rattle noise excited by ICE's (Internal Combustion Engine) fluctuating torque, is one of HEV powertrain issues. The predetermined fluctuating torque specification can be changed as detailed study for enhancement of fuel efficiency progressed in ICE development. When avoiding torsional NV by changing operation point of ICE, the chance to fuel economy enhancement can be limited. The detection of mismatch of system NV specification after all components are combined and tested can lead to inefficient rework of development process. Therefore, a development process which can efficiently achieve of both fuel economy enhancement and torsional NV from transmission and damper development stage is necessary.

Transmission VRS (TransMission Virtual and Real Simulator, M-VRS) which is a testbed of transmission and damper has been focused. M-VRS can verify torsional NV with actual transmission and damper by reproduce fluctuating torque of ICE using realtime simulation. Existing ICE model embedded in M-VRS and its physical components are different from predictive one. The verifiability between prediction and tested results can be one of the issue.

As a countermeasure, the prediction ICE model has been embedded on M-VRS by converting to real-time model using latest high speed solver. It has been confirmed to be capable of actual transmission operation and torsional NV verification. Also sensitivity study of ICE parameters, and ICE starting operation have been enabled (Fig.2, Fig.3).

The following items have been enabled in development stage of transmission and damper.

1) Improvement of verifiability when comparing prediction and result
2) Early detection of NV issues and feedback
3) Optimization study considering relationship between torsional NV and fuel efficiency of ICE

The above results have been reflected in development process, contributed with efficient achievement of both enhancement fuel economy and torsional NV.

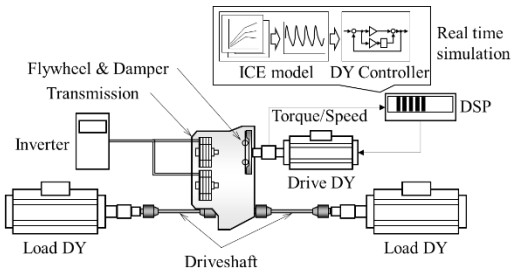

Fig.1 M-VRS Transmission & Damper testbed

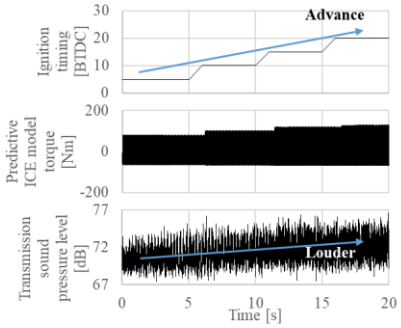

Fig.2 Reproduction of gear rattle noise during ICE loading

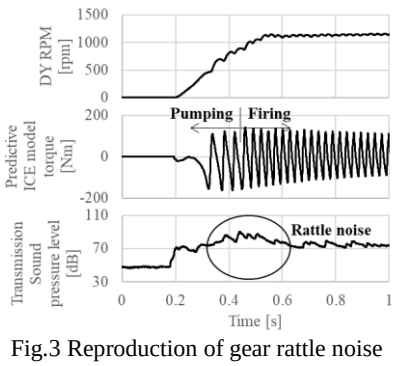

Fig.3 Reproduction of gear rattle noise during HEV ICE start

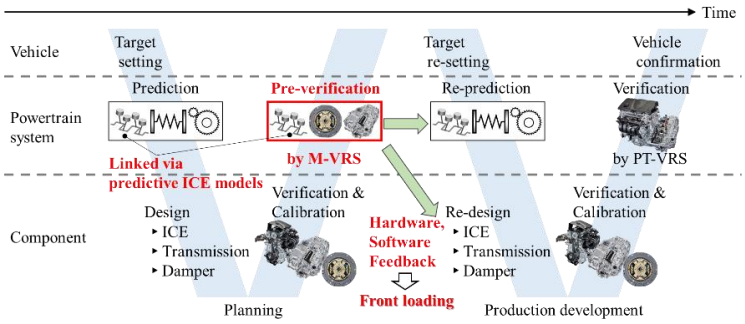

Fig.4 Enhanced torsional NV development process linking with ICE development