講演番号	022

文献番号	20226022

Study on Model-Based Development for Lean NOx Trap (3rd Report)

-Modeling of Lambda Sensor at Rich Condition-

Kenji Fujii [1)] Teppei Ohori [1)] Hironori Inomata [2)] Daiji Nagaoka [2)]

Yutaka Itagaki [1)] Hisashi Ozawa [1)] Naoya Ishikawa [1)]

1) Isuzu Advanced Enginieering Center, LTD
8 Tsuchidana, Fujsawa, Kanagawa, 252-0881, Japan
2) Isuzu Motors, LTD
8 Tsuchidana, Fujsawa, Kanagawa, 252-0881, Japan

KEY WORDS: **Heat engine, de-NOx catalyst, modeling,** lambda sensor (A1)

Lean NOx Trap(LNT) is one of the purification devices for nitrogen oxides (NOx), which is target gas to diesel exhaust gas regulations. Model-based development(MBD) is one of the method to improve the performance of LNT system efficiently. LNT storages NOx into adsorbent until defined amount under fuel lean atmosphere then regenerates NOx with fuel supply as reducing agent. LNT regeneration is controlled by the output of the lambda sensor, so we need a development of lambda sensor model in addition to LNT plant model. Because LNT plant model can not estimate the lambda value. Therefore, we tryed to create the lambda sensor model by using actual exhaust gas composition such as O_2, H_2, CO, HC and so on, because the lambda sensor value have cross-sensitivity by each emission gas. This method is the simple and easy way to development lambda sensor model. In this report, we introduce the results of create the lambda sensor model during LNT regeneration ivent as the third report of Study on Model-Based Development for Lean NOx Trap.

The lambda sensor value is defined by following formula. O,H,C concentration is the each atomic concentrations in the exhaust gas.

$$lambda = \frac{20.9}{20.9 - ([\mathrm{O\ concentration}]/2) + ([\mathrm{H\ concentration}]/4 + [\mathrm{C\ concentration}])}$$

In this study, data analysis was carried out with the following two assumptions.

1. The O_2 concentration change rapidly during LNT regeneration.
2. Ds lambda sensor model use LNT model output O_2 concentration.

Fig.1 is the actual lambda value and modified model estimation results at steady state condition in engine. The model estimation value showed relatively close to the actual measurement value at steady state condiions. Furthermore, the model value could be estimated even in a transient mode such as WLTC. The lambda sensor model is possible to estimate the lambda value from the exhaust gas composition, so we tried to create inverse model that calculates the exhaust gas composition from the actual lambda sensor value. Inverse model's input parameter is engine revolution, engine torque and lambda value. The gas concentaration of LNT inlet was estimated by three dimensional MAP from three parameters.

Fig.2 shows actual gas concentration of LNT inlet and inverse model estimation results in WLTC mode. The inverse model results was found that the gas concentration behavior could be relatively high accuracy, although there are some difference. Consequently, it is considered that inverse model for calcuate the exhaust gas concentration from actual lambda value is a relatively high accuracy and simple method.

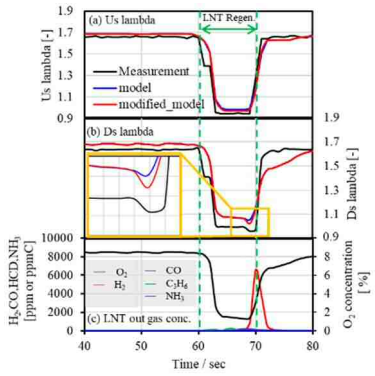

Fig.1 Measured and simulated results of engine test in LNT regeneration

This construction method of estimating the lambda sensor value from the gas composition is considered to be a simple and easy way. In addition, the behavior that Ds lambda sensor value fall sharply in the end of LNT regeneration, and H_2 was detect at the same time. This phenomenon shows that it is end of NOx reduction can be judged by the decrease of the Ds lambda sensor value due to H_2 detection from the LNT system out exhaust emissions.

Finally, this study was able to create a relatively high accurate model not only for estimating the lambda sensor value from the gas composition, but also as the inverse model for estimating the gas composition from the actual lambda sensor value, engine revolution and engine torque. Because of this method can create a practical model in a short time without detailed modeling of the internal structure of the lambda sensor, so it is considered to be a construction method that can contribute to the development of the high performance LNT system under MBD environment.

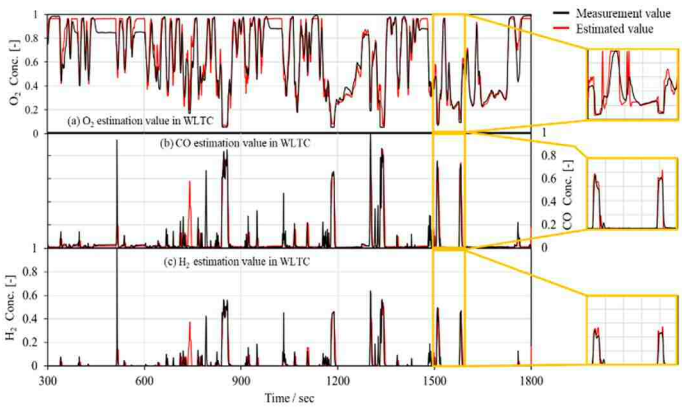

Fig.2 Measured and simulated results of engine out O_2, CO, H_2 gas concentration in WLTC mode