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Valve Train With Learning Control Features

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Abstract: The electro-hydraulic valve actuator (EHVA) system of a diesel engine has a fully controllable gas exchange valve lift and valve timing. The EHVA system can be utilized to follow existing valve lift profiles and provides possibility for utilization of modified or new valve lift profiles. Fast testing of different camshaft profiles is beneficial when new combustion concepts are tested or when new valve timing specifications needs to be studied or optimized with existing components. Comparison and testing of the different profiles with EHVA system is efficient, since all necessary changes can be done electrically. Therefore the system should be able to follow the pre-generated valve lift curves as precise as possible. It is known, that traditional controllers are having problems to achieve reasonable good tracking due to dynamics of the hydraulic system. This can be improved by using more complex and advanced controllers, but tuning of parameters of such controller is very time consum-

ing. One solution is to use an adaptive or a learning controller.

In this study a controller with a learning feature is investigated and introduced. The modification of the reference signal is based on the detected errors during the valve event, which is suitable method for a repeating work cycle. Performance of the controller is simulated and some experimental tests are presented.

The EHVA system is additionally integrated with security features for stopping and starting control processes when needed. The lift profiles of the gas exchange valves can be changed or modified without need of stopping the engine. If only opening and closing moment needs to be adjusted, the controller system allows this without influence to curve shape.

The controller was found capable to keep the tracking error of the gas exchange valve lift within acceptable range and capable to respond to changes in the running conditions within adequate time.