A Study on Hybrid Power Unit for Small Competition Vehicles (Fundamental Consideration on Electronic Operation System for Internal Combustion Engine)

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Abstract

Hybrid vehicles have multiple power sources and are energy efficient; this improves both their fuel efficiency and dynamic performance. Therefore, hybrid vehicles have recently been used as competition vehicles, which require high powertrain performance. The system of hybrid vehicle consists of two power resources: an internal combustion engine and motor, each of which requires precise control. Controlling the output of an internal combustion engine is difficult. In this study, the dynamic response of an actuator to an electronic throttle system is investigated. The experimental results indicate that the optimized parameters improve the dynamic response.

1 Introduction

Various companies have recently begun using hybrid systems for competitive vehicles. An internal combustion engine (ICE) produces high torque at high speeds, and one or more electric motors produce high torque at low speeds. The most important objective of a small competition vehicle is to improve vehicle performance and reduce lap times. This study focused on the performance of a small hybrid racing car, Formula Hybrid [1]. The outputs of the electric motor and ICE must be precisely controlled by a command signal [2]. The motor current can be easily controlled using a motor driver, But controlling engine output is difficult. So this study focused on investigated the electronic throttle controlled by an ICE.

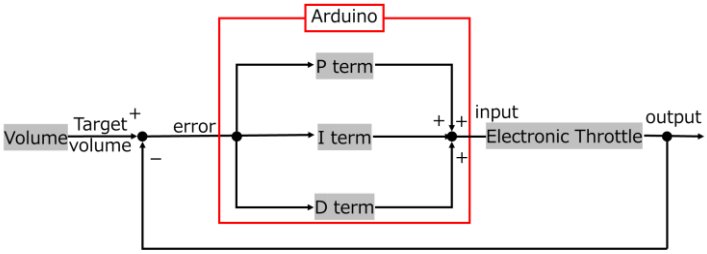

Figure 1: Arduino calculation algorithm diagram.

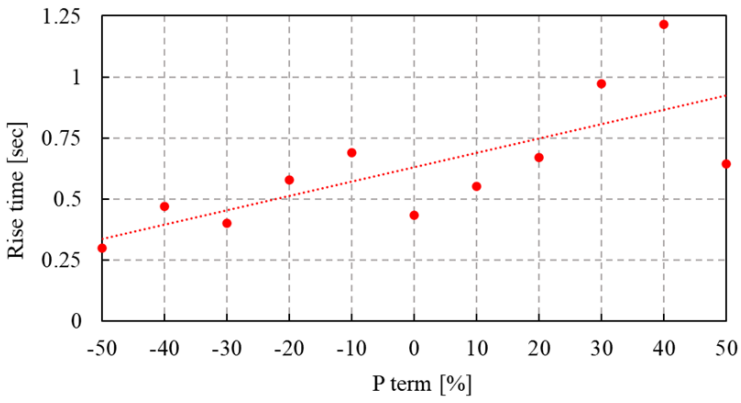

Figure 2: Rise time of P term.


Figure 3: Electronic throttle.

2 Electronic Operation System for ICE in Small Competition Vehicles

An Arduino was used as the controller of the electronic throttle, and the algorithm was the PID method. Since the P term is a proportional gain and plays the most fundamental role in bringing the output closer to the target value, only the P term was changed in this tentatively experimences. The characteristics of PID control were compared and examined about rise time, settling time and overshoot when the gain of P term is changed. Figure 1 shows calculation algorithm diagram.

Figure 2 shows the rise time of P term. Figure 3 shows the electronic throttle. The rise time is 0.14 sec faster than the standards (0%) for P term. The settling time is 0.11 sec faster than the standards for P term. The overshoot is 11.5 sec faster than the standards for P term. The rise time, settling time, and overshoot of the P term tended to increase as the coefficient was increased.

3 Conclusion

For the implementation of an electronic throttle, the tracking of the demanded amount when the accelerator pedal is operated was verified. By changing several terms in this study, we believe we can comprehensively evaluate the performance of the electronic throttle. We will continue to conduct experiments to determine the best P,I and D combination that can be used as a benchmark for the implementation of the system.

References

[1] Available online: https://www.sae.org/attend/student-events/formula-hybrid/.
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