Highly Precise Phase-Locked Loop DC Motor Control System with a Reduced Number of Parts

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Phase-locked loop (PLL) control has been widely applied, for example, in hard disk drives, which require extremely precise control of their rotational speed. The present study is the development of a novel PLL system that is both sufficiently robust against load changes and low in cost. In conventional PLL control, a periodic signal generated by a continuous light beam that is intermittently interrupted by disk slits is compared in phase with a reference pulse signal. A blinking light seen through the rotating propellers of an electric fan inspired me to create a new control method for motors. For the phase comparison, a blinking source light beam as a reference signal passes through disk slits in the proposed method. From changing only the flashing light-emitting portion of the rotary encoder, having a phase detector becomes unnecessary with the proposed mechanism, and so the number of parts is reduced. The rotary encoder is used not only as a rotational speed sensor but also as a phase detector. Moreover, to apply the proposed method, a motor can also synchronize a rotating object as a reference signal. Experiments showed that rotation stability had equivalent performance to that of the conventional method. Rotational speed sweep tests indicated that rotational speed precisely followed changes in the reference pulse signal. It was confirmed that synchronization was maintained even if the load changed. The developed system's reduced number of parts while maintaining the rotational stability and robustness of the conventional method indicates that the proposed method should allow application of the system in a very wide range of fields.

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