Claims:

1. An active disturbance rejection control (ADRC) system, comprising:

an extended state observer (ESO) module that is configured to:

receive input information comprising a torque reference signal for driving a motor, and a speed value that is a measured output of the motor passed to a first low-pass filter (LPF);

determine, based on the input information, an estimated speed value and an estimated disturbance value; and

send the estimated speed value as a feedback control signal, and the estimated disturbance value as a feedforward control signal;

wherein the estimated speed value is determined at least in part based on a second LPF that is of the same form as the first LPF, and the estimated disturbance value is selectable between an output of an integral controller and an output of a proportional-integral controller of the ESO module; or

wherein the estimated speed value is determined based on the output of a proportional-integral-derivative controller of the ESO module, and the estimated disturbance value is selectable between: an output of an integral controller of the ESO module; and an output of a proportional-integral controller of the ESO module; and the output of the proportional-integral-derivative controller of the ESO module.

2. The ADRC system of claim 1, wherein the estimated speed value is determined at least in part based on the second LPF, and the second LPF is of the same form as the first LPF, and the estimated disturbance value is selectable between an output of the integral controller and the output of the proportional-integral controller of the ESO module.

3. The ADRC system of claim 1 or 2, wherein the ESO module has a fourth-order characteristic polynomial.

4. The ADRC system according to claim 3, wherein the ESO module is characterized by the following transfer functions:

$$\Phi_r(s) = \frac{\Omega(s)}{\Omega^*(s)} = \frac{\Delta_3(s+k_{ps})}{\Delta_3(s+k_{ps})+(k_b-1)sG_3(s)}$$
$$\Phi_d(s) = \frac{\Omega(s)}{d_n(s)} = \frac{k_b G_3(s)}{\Delta_3(s+k_{ps})+(k_b-1)sG_3(s)}$$
$$\Phi_n(s) = \frac{\Omega(s)}{-s\delta_p(s)} = 1 - s\Phi_d(s)$$

where $\Phi_r(s)$ is the transfer function from the command reference to the output; $\Phi_d(s)$ is the transfer function from the disturbance to the output; $\Phi_n(s)$ is the transfer function from the measurement noise to the output; Δ_3 is the characteristic polynomial; Ω^* is a reference of mechanical angular velocity; Ω is a mechanical angular velocity; k_{ps} is a proportional gain; k_b is control gain ratio; *s* is a Laplace Operator; $s\delta_p(s)$ is a speed measurement noise; $G_3(s)$ is a transfer function based on *s* and angular velocity; and d_n is a disturbance.

5. The ADCR system of claim 1 or 2, wherein a transfer function of the second LPF is:

$$G_{\mathrm{LPF}}(s) = \frac{\omega_{f2}}{s+\omega_{f1}}$$

where ω_{f1} and ω_{f2} are gains and *s* is the Laplace Operator.

6. The ADRC system of claim 5, wherein the second LPF is set to be an integrator.

7. The ADRC system of claim 1, wherein the estimated speed value is determined based on the output of the proportional-integral-derivative controller of the ESO module.