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Opinion Article

# Power System Control Method of Stepping-Type Anchoring Equipment

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## ABOUT THE STUDY

A crucial aspect in coal mining is anchoring. The high rate of occurrence of geological dangers in underground coal seams, combined with a significant contingency, make this operation extremely difficult. Roadway support activities account for more than 60% of overall drilling time, according to figures. Therefore, the enhancement of the dependability and work efficiency of anchor support operations would directly enhance the speed and efficiency of roadway excavation.

A stable and efficient electro-hydraulic power system is the foundation and assurance for boosting mining equipment operation efficiency. There are numerous electro-hydraulic control systems available today, the most common of which are valve control modes based on Intelligent PI control, intelligent PID control, SMC, and pump control modes based on variable speed driver technology. Machine-mounted rotary hydraulic roof bolters are the most often utilized anchoring equipment [1]. To optimize the PID parameters, the electro-hydraulic system in such equipment frequently employs the Ziegler-Nichols algorithm. Although this control method is simple and easy to implement, parameter adjustment is more complicated, and the control accuracy of hydraulic systems with low damping, strong nonlinearity, and time-varying parameters is not high. To improve the stability of the hydraulic system under time-varying parameters and large external load fluctuations, we designed a set of adaptive robust force controllers and used the gradient descent method to adjust the controller parameters. However, this method has drawbacks such as poor low-speed stability, a limited speed adjustment range, delayed reaction, and high oil quality requirements. Wang suggested a roof bolter hydraulic system control approach based on a variable-frequency pump-controlled hydraulic drive system and PID parameter tuning using an intelligent fusion optimization algorithm. This ensures that the roof bolter operates at full power and performs well under reasonable parameter-matching working conditions. Hoang investigated the effect of system parameter uncertainty and external interference on system control and proposed a new control strategy for the control of hybrid fluid power equipment based on the fundamentals of the fast terminal sliding mode, ensuring that the tracking error converges to the origin in a limited time [2].

A number of clever algorithms were used to optimize and tune the PID control parameters in the valve control system or pump-control system of the anchoring equipment to increase the control accuracy and stability of the equipment. Because the pump-control hydraulic system is powered by a frequency-conversion Permanent Magnet Synchronous Motor (PMSM), the controller, PMSM, hydraulic pump, and other components display multivariable and nonlinear strong coupling effects, resulting in more complex system pulses [3].

Stepping-type anchoring equipment was designed in this effort. The entire coupling mechanism of the converter-PMSM, pump-controlled motor, and pump-controlled hydraulic cylinder was investigated, and a mathematical model of the walking anchoring equipment's drive control system was built. Furthermore, a coordinated control technique for PMSM harmonic suppression compensation was proposed to actively suppress the pulsation of stepping-type anchoring equipment [4].

The stepping-type anchoring equipment was created to improve the anchoring equipment's roadway flexibility. The equipment consists mostly of a mechanical system and a power system. Subsystems of the mechanical system include an advance support system, an anchor net-laying system, a walking system, and a roof bolter system. The walking system walks forward using hydraulic cylinders and is utilized for movable movement of anchoring equipment; the anchor net-laying system completes net-laying work before anchoring the fully mechanized excavation face [5].

## CONCLUSION

The power system is made up of a hydraulic system as well as an electric and control system. A quantitative hydraulic pump, an electromagnetic reversing valve, a supporting column hydraulic cylinder, a quantitative motor and pushing cylinder, and other components comprise the hydraulic system. A PMSM, a controller, and its controller compose the electric and control system. The stepping-type anchoring equipment operates as follows: after reaching the designated working position, the

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hydraulic cylinder of the walking system is supported on the ground; meanwhile, the hydraulic cylinder of the advance support system is supported on the ground, and the anchor net-laying system is extended to spread the anchor net to the roadway's roof and sidewalls. Finally, the anchoring system adjusts the bolter drill's posture so that it can execute anchoring operations in a variety of positions.

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