

Balance and Tracking Control of Ball and Plate Systems

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Abstract

In this video, the digital signal processor based (DSP-based) ball and plate control system is introduced. The plate is actuated by two DC motors. To sense the position of the ball, a resistive touch panel is utilized. The optical encoder with resolution 1000 pluses/rev attached to the shaft of the DC motor is used to measure the angular displacement of the motor. The system is controlled by a DSP (150MHz/32-bit) board equipped with a 12-bit D/A converter. The sampling frequency of the system is chosen to be 1 kHz. The voltage signals are generated according to the designed control law and are also supplied to power amplifiers that derive the DC motors. The signal from the touch panel is passed through a digital low-pass filter to reduce the effect of sensor noise. The ball and plate system is a highly nonlinear and coupled system. Due to existence of the centrifugal force, the system relative degree is not well defined. Moreover, the centrifugal force provides a strong positive feedback and easily leads to the peaking phenomenon. The system model is approximated as two decoupled systems. The backstepping control design approach is used to design the controller for balance and tracking control. The video shows the effectiveness of the designed control system.