Analysis of Influencing Parameters of Slider-Crank Mechanism

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DESCRIPTION

The slider-crank mechanism is used widely for engineering applications and by researchers in their studies. The kinematic analysis of the slider-rank mechanism is with pair of links. The dynamic analysis of the slider-crank mechanism in joint clearances and one connected to another. The output motion error of an offset slider-crank mechanism is with pair of links one interlinked with another. A mathematical model based on continuous contact force for dynamic analysis and experimentally validated using the slider-crank mechanism. The analysis is performed using two different slider-crank mechanisms. Slider-crank mechanism-1 is used for the analysis of the effect of the joint clearance. The observations are used to design slider-crank mechanism-2, which is used for the analysis of the effect of link length tolerance and joint clearance.

The effect of joint clearance is analysed using the slider-crank mechanism-1. The variable clearance at both sides of the connecting rod is obtained using three different pin pairs with different diameters. To analyse the effect of joint clearance, joint clearance at both ends of the connecting rod is varied. Three joint clearances are obtained, by drilling holes of 24 mm diameters in the connecting rod and fabricating pin pairs having diameter as 22 mm (pair 1), 23 mm (pair 2), and 24 mm (pair 3). The pins are having external threads at the bottom and are screwed in the crank/slider through the connecting rod holes.

The simulation of slider-crank mechanism-1 is done by modelling the mechanism in ADAMS. The displacement is measured at the slider centre. The links are modelled using the properties of the fabricated components. To model the clearance, the joints are modelled using the 'contact model' in the ADAMS. The model is simulated at a speed of 30 rad/sec (5rpm) which is specified at the joint between ground and crank. The slider displacement is the position of the slider centre point in the 'X' direction. The joint clearance is varied by changing the pin pairs at the both sides of connecting rod. Slider displacement versus time for pair 3 for five crank rotations.

The total slider displacement is calculated as the difference in the maximum and minimum displacement from the five crank rotations. The components are fabricated from a 20 mm thick MS block. The pins are fabricated from an MS bar. The mechanism is driven using DC motor which is screwed to the table. The motor shaft is supported with a ball bearing in the table. The crank is keyed to the motor shaft. A linear guideway with a runner is screwed to the table. The slider of the mechanism is screwed using the pins to the runner. The pins are screwed to crank and slider through the holes in the connecting rod. The dry friction joints are considered for the analysis as there is no lubricant. An ultrasonic sensor is used to measure the position of the slider.

CONCLUSION

Motor speed is controlled through a DC rectifier. An indexing disk is designed to record slider displacement at a constant interval. The indexing disk is a cardboard sheet of 260 mm diameter where 35 holes are punched at 100 intervals and is screwed to the crank. An IR sensor is fixed on the table which locates a hole on the indexing disk and sends a signal to the ultrasonic sensor to record the position of the slider. The ultrasonic sensor output is recorded at each 5 mm movement of the slider. The data is stored in the program in the computer. Linear interpolation is used to locate the exact location of the slider. At the time of experimentation, the Arduino program transforms ultrasonic sensor readings to slider displacement using the calibrated data. The experiments are performed for the three pin pairs on the experimental setup using the measurement system. The experiments are performed at 5rpm crank speed. The DC motor is controlled using a DC rectifier, rotates the crank at a constant speed of 30 rad/sec. When the IR sensor mounted near the indexing disk locates a hole, it sends a signal to the Arduino. The Arduino program reads the sensor data at that instant and records the slider position.

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