

Dynamic modeling and simulation of windshield wiper mechanism

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Abstract

The large windshield glass surface of the automotive requires to be cleaned for a good visibility. The wiper arm mechanism driven by an electric motor is well adopted to clean the large surface area of the windshield. Most of the Wiper mechanisms adopts the simple four bar mechanism or parallelogram mechanism for the working which works by transmitting the power from an electric motor to the roots of wiper arms converting rotary motion into back and forth motion. The present work attempts to simulate and analyze the dynamic behavior of a wiper tandem mechanism by using the software packages, CATIA V5R20 for modeling; ANSYS for analysis considering the mechanism as multibody system. The paper also presents the distribution of equivalent stress in the coupling linkages and joints of the mechanism to predict the probable area of failure.

The wiper mechanism was developed to clean the water or dust from the windshield glass of an automobile. The widely adopted wiper mechanism systems includes tandem system, opposed system, single arm system and driver position system tandem wiper mechanism which operates on the parallelogram principle consisting two wipers; one is used to clean the windshield glass at the driver's side while the another to clean the passenger's side. The back and forth motion of the wiper is usually operated by an electric motor. The mechanism mainly comprises the driving unit that is an electric geared motor, the linkage mechanism, wiper arms and the rubber blades. An electric motor is provided with worm gear reduction which reduces the speed of the motor with considerable increase in the driving torque. The speed reduction gear produces an enough driving torque to operate the wiper arms. The output shaft of the motor is coupled with the drive link which further drives the coupler connecting links, converting the rotational motion into translational. The force from the motor to the coupler link turns the wiper arms through the pivots. The rubber blades are held by the wiper through number of pressure points also called as "claws", the claws ensure the uniform pressure distribution on the windshield glass along the total length of the blade which ensures the friction between the rubber and the glass. The wiper can rotate about the pivot and the spring mechanism between the pivot and the drive link brings the wiper arm to rest close near to the windshield.

The whole assembly of motor, crank (drive link), coupler link and the pivots are made rigidly fixed underneath of the dashboard. Some manufacturers produce two different assemblies of the wiper and the wiper mechanism while some make a complete assembly of both along with the motor. The whole assembly comprising different parts are made up of different materials. The crank (drive link) and the coupler linkages are made up of steel coated with zinc called as Galvanized steel; the coating of zinc protects the steel from corrosion. The pivot transmitting force from linkage mechanism to the wiper arm are also made up of Galvanized steel. The wiper arm is manufactured from Aluminum alloy and the rubber is made up of natural rubber which is quite soft at the wiping edge and hard at rest of the holding portion. The other parts including springs, nuts, bolts and the supporting bracket is made up of steel and are directly purchased from the specialized companies. Copilusi Cristian and Veliscu Viorica, "An Approach Regarding Windshield Wiper Mechanism Design" have presented a computer oriented numerical approach of parallelogram mechanism used in automobile windscreen wiper system and evaluated the frictional force between the rubber blades and the windscreen glass.