Abstract

Shimmy of Nose Landing Gear (NLG) is a self-excited dynamic instability that may occur during taxiing, takeoff, and landing of an aircraft. Shimmy vibration is an undesirable phenomenon which may be suppressed by application of active Magneto Rheological (MR) dampers. The present investigation is aimed to introduce a torsional MR damper as an additional device in the system and study the effect on dynamics of NLG to suppress the undesirable vibration.

A torsional damper was designed based on the Bingham plastic shear flow model. The designed damper was fabricated and an experimental setup was established to characterize the damper.

A finite element model of NLG was developed and the free vibration analysis was performed. The modal model was developed based on the modal information and the response analysis was carried out. The response levels were monitored at the piston tip of the NLG with various loading conditions on both left and right tyres of NLG without and with MR damper. The study revealed that imbalanced loading condition is the source for vibration and the acceleration level was reduced with the implementation of the MR damper. The closed loop solution was obtained using full state feedback control scheme by the pole-placement technique. The study concluded that the active MR damper with feedback control system can be recommended for vibration control of NLG.

The shimmy model of dual wheel NLG was developed based on the Li's formulation for studying the oscillatory motion of the landing gear with different conditions i.e., linear and nonlinear analysis, effect of free play, runway excitation and its interaction with free play. The analysis concluded that critical velocity is lowered either by the presence of small amount of free play or the runway roughness. The combined effect of free play and runway roughness causes more adverse impact on NLG stability. Finally the study has been performed to postpone the dynamic instability by implementing the MR damper. It is to be mentioned here that the MR damper is a good semi-active device for vibration reduction in nose landing gear of an aircraft.

Key words: Magneto Rheological Damper, Nose Landing Gear, Shimmy, Free Play, Runway, Vibration Control.