Modelling And Simulation of Four-Stage Collision Energy Absorption System Based on Magneto Rheological Absorber

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Abstract for Seminar 2

The world is moving towards applying intelligent technologies in automobiles, with focus on the development of autonomous vehicles. These vehicles are equipped with devices to predict and avoid dangerous situations such as vehicle crashes, pedestrian hits, etc. Such devices are mostly used in pre-crash management but not during crash. Hence, there is a requirement of smart crash energy absorption system that works during crashes and modulates its energy absorption capability as per the severity of crash. Thus, the proposed methodology involves development of mathematical modelling and dynamic simulation of a four-stage collision energy absorption system.

The Dodge Neon vehicle is considered as a base model with 4 DoF lumped parameter modelling (LPM). The proposed model is equipped with four impact absorption elements such as a bumper, magneto rheological absorber (MRA), spring, and a piston-cylinder with shear plate assembly, that are in series. The MRA is an intelligent device which plays a vital role to make a system to be smart or semi-active by adjusting the crash absorbing capability while altering the power distribution to MRA as per the severity of crash.

The modified Bouc-Wen model is utilized for MRA, which is non-linear in nature, and the spring-dashpot model has been considered for other elements of the proposed system. Dynamic expressions have been derived and simulated to validate the capability of the proposed model against the existing base model. The proposed model exhibits great capability in terms of displacement, deceleration, and time of crash of the occupant's cabin. The proposed design can also be utilized for the electrical vehicles (EVs) as an add-on system because of the absence of crushable mechanical elements