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Vibration based methods for damage detection in structures

Emil Manoach
Bulgarian Academy of Sciences, Bulgaria

Vibration based damage detection methods are among the most popular and promising approaches for health monitoring of structures. In this work, a critical review of different methods for damage detection of structures is presented. The theoretical bases of the most popular methods based on the changes in the modal properties of the structures are deduced. The review includes the modal displacements, the mode shape slopes, the modal curvatures and the strain energy methods. Different variants of these methods are discussed. The efficiencies of all these methods are compared by using a finite element analysis of intact and damaged beams and plates. The methods are tested experimentally by using a scanning laser vibrometer to measure the modal properties of specially prepared composite structures with delaminations. All these methods are compared with the damage detection method based on the analysis of the Poincare maps of the motion of the structures. Conclusions about the advantages and applicability of the considered methods are deduced.

e.manoach@imbm.bas.bg

Active suspension based on shock-absorbers for which lyophobic heterogeneous system: Repulsive clathrates are used instead of oil

Eroshenko Valentin
National Technical Univercity of Ukraine "Kyiv Polytechnic Institute", Ukraine

Report provides information about the new working body for efficient mechanical energy dissipation. The working body is presented by the system of porous powder and non-wetting liquid. The principles of energy dissipation are based not on viscous friction of the fluid, but on the use of pronounced hysteresis of pressure during compression and decompression cycle of the system: the pressure of forced intrusion of the liquid into the pores of the particles of the powder is approximately 10 times greater than the pressure of spontaneous extrusion of the fluid from the pores. Rheological and dynamic characteristics of used heterogeneous lyophobic systems (repulsive clathrates) are provided. Shock-absorber consists of two oppositely connected chambers filled with Heterogeneous Lyophobic System (HLS) and separated by a piston (the latter is associated with the piston rod). When moving the piston in the direction of one of the chambers the pressure of that chamber increases and it provokes the intrusion of the liquid into the pores, at the same time in the opposite chamber spontaneous liquid extrusion at low pressure takes place. Thus, to produce a hysteresis loop in the "pressure-volume" coordinates (the area of the loop characterizes energy dissipated) it is sufficient to move the rod-sided piston in one of the direction, not necessarily in "back and forth" regime. To dissipate the same amount of mechanical energy by a new shock-absorber 100 times less volume of HLS is required in comparison with the volume of the oil in conventional shock-absorbers. Performed tests confirm effective energy dissipation rod speed up to 4.0 m/s and a frequency range of 0.5 to 22 Hz. In the proposed concept of active vehicle suspension for the first time it is possible to completely resolve the contradiction of "comfort vs road grip" characteristics through the use of shock-absorbers with a force on the rod which is independent on the speed of its movement. Independent from the road profile force at the rod provides comfort for passengers and constant reliable grip of the wheels with the road.

eroshenko@kpi.ua