World Academy of Science, Engineering and Technology
International Journal of Industrial and Systems Engineering
Vol:11, No:06, 2017

Determination of Friction and Damping Coefficients of Folded Cover Mechanism Deployed by Torsion Springs

Authors : I. Yilmaz, O. Taga, F. Kosar, O. Keles

Abstract : In this study, friction and damping coefficients of folded cover mechanism were obtained in accordance with experimental studies and data. Friction and damping coefficients are the most important inputs to accomplish a mechanism analysis. Friction and damping are two objects that change the time of deployment of mechanisms and their dynamic behaviors. Though recommended friction coefficient values exist in literature, damping is differentiating feature according to mechanic systems. So the damping coefficient should be obtained from mechanism test outputs. In this study, the folded cover mechanism use torsion springs for deploying covers that are formerly close folded position. Torsion springs provide folded covers with desirable deploying time according to variable environmental conditions. To verify all design revisions with system tests will be so costly so that some decisions are taken in accordance with numerical methods. In this study, there are two folded covers required to deploy simultaneously. Scotch-yoke and crank-rod mechanisms were combined to deploy folded covers simultaneously. The mechanism was unlocked with a pyrotechnic bolt onto scotch-yoke disc. When pyrotechnic bolt was exploded, torsion springs provided rotational movement for mechanism. Quick motion camera was recording dynamic behaviors of system during deployment case. Dynamic model of mechanism was modeled as rigid body with Adams MBD (multi body dynamics) then torque values provided by torsion springs were used as an input. A well-advised range of friction and damping coefficients were defined in Adams DOE (design of experiment) then a large number of analyses were performed until deployment time of folded covers run in with test data observed in record of quick motion camera, thus the deployment time of mechanism and dynamic behaviors were obtained. Same mechanism was tested with different torsion springs and torque values then outputs were compared with numerical models. According to comparison, it was understood that friction and damping coefficients obtained in this study can be used safely when studying on folded objects required to deploy simultaneously. In addition to model generated with Adams as rigid body the finite element model of folded mechanism was generated with Abaqus then the outputs of rigid body model and finite element model was compared. Finally, the reasonable solutions were suggested about different outputs of these solution methods.

Keywords : damping, friction, pyro-technic, scotch-yoke
Conference Title : ICESDA 2017 : International Conference on Engineering Systems Design and Analysis
Conference Location : San Francisco, United States
Conference Dates : June 07-08, 2017