World Academy of Science, Engineering and Technology
International Journal of Mechanical and Mechatronics Engineering
Vol:14, No:12, 2020

An Optimization Algorithm for Reducing the Liquid Oscillation in the Moving Containers

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Abstract : Liquid sloshing is a crucial problem for the dynamic of moving containers in the packaging industries. Sloshing issues have been so far mainly modeled within the framework of fluid dynamics or by using equivalent mechanical models with different kinds of movements and shapes of containers. Nevertheless, these approaches do not allow to determinate the shape of the free surface of the liquid in case of the irregular shape of the moving containers, so that experimental measurements may be required. If there is too much slosh in the moving tank, the liquid can be splashed out on the packages. So, the free surface oscillation must be controlled/reduced to eliminate the splashing. The purpose of this research is to propose an optimization algorithm for finding an optimum command law to reduce surface elevation. In the first step, the free surface of the liquid is simulated based on the separation variable and weak formulation models. Then Genetic and Gradient algorithms are developed for finding the optimum command law. The optimum command law is compared with existing command laws, and the results show that there is a significant difference in surface oscillation between optimum and existing command laws. This algorithm is applicable for different varieties of bottles in case of using the camera for detecting the liquid elevation, and it can produce new command laws for different kinds of tanks to reduce the surface oscillation and remove the splashing phenomenon.

Keywords : sloshing phenomenon, separation variables, weak formulation, optimization algorithm, command law
Conference Title : ICDVCA 2020 : International Conference on Dynamics, Vibration and Control Applications
Conference Location : Paris, France
Conference Dates : December 28-29, 2020