Control for Slosh-Free of an Open Container

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Abstract

This article describes two methods for controlling the surface of a liquid in an open container as it is being carried by a robot arm. Both methods make use of the fundamental mode of oscillation and damping of the liquid in the container as predicted from a boundary element model of the fluid. The first method uses an infinite impulse response filter to alter the acceleration profile so that the liquid remains level except for a single wave at the beginning and end of the motion. The motion of the liquid is similar to that of a simple pendulum. The second method removes the remaining two surface oscillations by tilting the container parallel to the beginning and ending wave. A double pendulum model is used to determine the trajectory for this motion. Experimental results of a FANUC S-800 robot moving a 230 mm diameter hemispherical container of water are presented.