Generating Swing-suppressed Maneuvers for Crane Systems with Rate Saturation

Agostini, M.J. Parker, G.G. Schaub, H. Groom, K. Robinett, R.D., III
Michigan Technological University, Houghton, MI, USA;

Abstract

Offline crane maneuvers, resulting in zero residual payload swing, have been explored previously using parameterized sets of basis functions. Assumptions usually included an ideal servo response and symmetric inputs. Nonsymmetric maneuvers, in general, do not have closed-form basis function solutions. Actuator dynamics further complicate maneuver generation by introducing nonlinearities such as saturation. One way to circumvent saturation is to constrain crane operation below the saturation levels of the actuators. This limits the set of available maneuvers and can lead to slower, more costly crane operation. This work explores the effects of a common servo nonlinearity, velocity saturation, on the swing-free maneuver generation process. A method is presented for maneuver generation that exploits speed saturation while still yielding near swing-free payload motion. An optimization code is used to generate basis function parameters where the cost function includes the speed saturation effects via a simulation of the payload dynamics. Experimental results using a 1/16th scale crane are presented to illustrate the method.