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Abstract

The current collection system consists of a pantograph placed on the roof top of a trains' vehicle and overhead contact wire supported by evenly spaced vertical holders which supply the current to the pantograph from the electric power grid. Most of the pantographs produce averagely good performances at low and medium speeds, approximately less than 250 km/h. However, at higher speeds, the response of the pantographs is distorted. Thus the stability of the current collection is in peril. In addition, due to vertical vibration of the car body during high speed, contact force variation occurs between the pantograph and overhead wire. Therefore, it is necessary to maintain the contact between pantograph and overhead wire. In this study, the multi-body dynamics analysis is used to model the flexible body of overhead wire. An excitation experiment is performed in order to determine the parameters of pantograph. With consideration of vertical body vibration, an active pantograph control is developed to eliminate the effect of vibration to contact force, reduce the maximum peaks and avoid contact loss.

Keywords—Multi-body Dynamic Analysis; Active Pantograph; Interaction; Active Control.

I. METHODOLOGY

A stationary pantograph excitation experiment is performed with sinusoidal displacement input acting on top of the contact plate as in Fig. 1. The output data recorded from the experiment are contact force, displacements of pan head and support. The pantograph parameters are identified from comparison between experiment and model. The contact wire is modeled using Absolute Nodal Coordinate Formulation accompanied with damping parameter [1]. The contact wire parameters are taken from the previous published researches [2]. In previous study of active pantograph control, the effect of vertical body vibration was never been considered [3]. It has been estimated that 30 % of the contact force variation is contributed by the vertical vibration at frequency of lower than 16 Hz [4]. This means the vertical acceleration of body vibration adds about 5 to 10 N amplitude of force fluctuations on the contact wire and pantograph interaction. Figure 2 shows the contact wire and pantograph interaction system. Figure 3 shows the block diagram of the interaction flow. With the objective of canceling the vertical body vibration y_B, the contact force f_1 is a function of the different between contact wire displacement y_C and pantograph contact strip displacement y_{P1}.

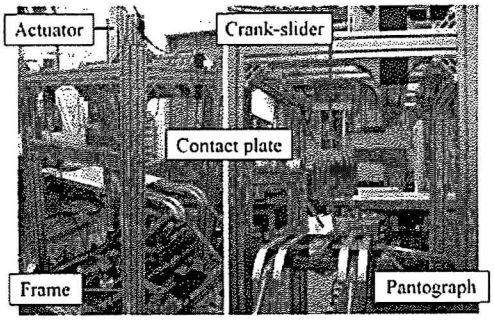

Figure 1. Pantograph excitation experiment setup

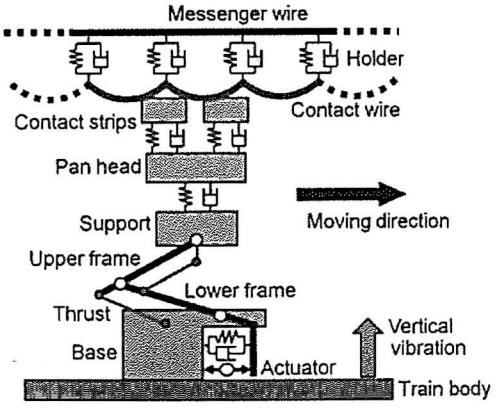

Figure 2. Contact wire and pantograph interaction system

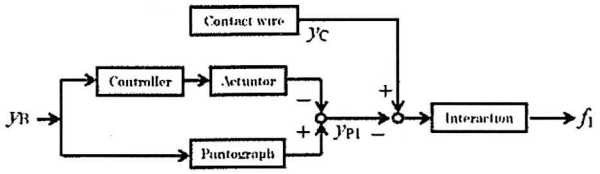

Figure 3. Block diagram of contact wire and pantograph interaction

II. CONCLUSION

The pantograph parameters have been identified from comparison with experiment. The vertical body vibration has been considered in the development of active pantograph. The analysis using multi-body dynamics approach has been performed and the contact force variations have been reduced by using cancelation control strategy as shown by Fig. 4.

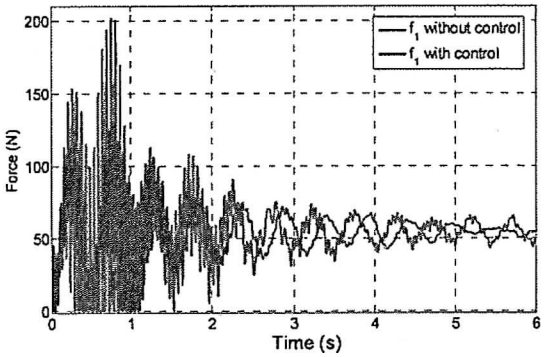

Figure 4. Contact force at stationary pantograph

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