Suppression of the impact oscillations between a pantograph and an overhead rigid conductor line in a railway current collection system

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Abstract

The wavy wear on the surface of the conductor line in the acceleration and the deceleration sections or the curve section can be produced by the repeated electric ark. The contact force between the pantograph and the conductor line can fluctuate by the wavy wear. When the contact force is lost, the pantograph separates from the conductor line and this phenomenon is called contact loss.

As shown in Fig. 1, we modeled the contact loss between the pantograph and conductor line with the wavy wear as the impact oscillations between a spring-supported beam and a sinusoidal vibrating rigid body. It is assumed that the impacts take place at a midpoint of the beam. We theoretically study the impact oscillations based on the theory of discrete dynamical system and the numerical calculations.

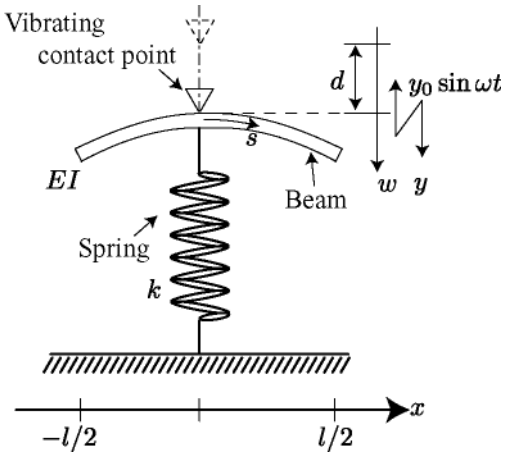

Fig.1 Analytical model

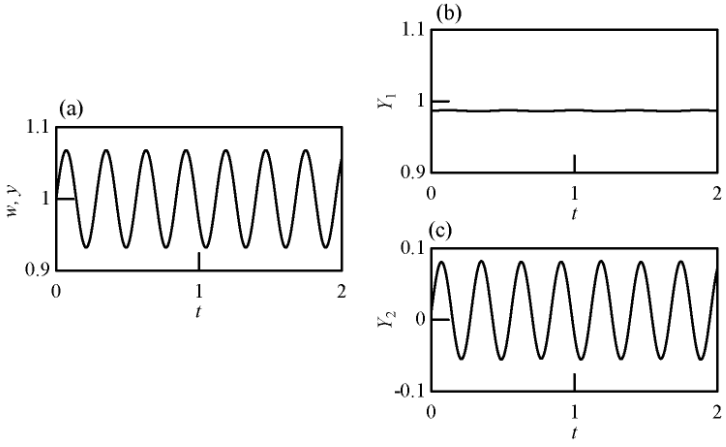

Fig. 2 Theoretical results (a) time histories of w and y (b) time history of Y1 (c) time history of Y2 (= 22.5)

Figure 2 (a) shows the time histories of the displacement of the vibrating rigid body y and the lateral displacements of the beam w when is near the second mode natural frequency. In this case (= 22.5), the contact loss cannot be produced and the pantograph is in contact with the conductor line. Figure 2 (b) and (c) shows the time histories of the displacement of the

first mode component Y1 and second mode component Y2. Y1 is always a constant and Y2 changes sinusoidally just as does y. Thus, Y2 acts like a dynamic vibration absorber to reduce the first mode vibration and suppresses the contact loss between the beam and the vibration plate.

We conduct the experiments with a model that is on the analytical model to confirm the theoretical results. Typical features of the impact oscillations and the suppressions of impact oscillations are experimentally observed. The theoretical results are qualitatively agreement with the experimental ones.