

Keynote Speech

Friday, December 14, 2007

9:00am – 10:00am

On the mechanical mechanism of stick and non-stick motions in a simplified brake dynamical system

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Abstract: The nonlinear dynamics mechanism of stick and non-stick motions in a brake system under a periodical excitation is presented. The necessary and sufficient conditions for motions switching and sliding on the boundary are developed, which can be used for slide mode controls for such a system. To achieve the specific motions, the switching sets and planes based on the discontinuous boundaries of motion are introduced, and the basic mappings are developed for the mapping structures of periodic motions. Further, periodic motion and stability will be analytically predicted. Illustrations of periodic motions will be presented from analytical predictions. In addition, the corresponding analytical conditions will be presented through the relative force responses. From such illustrations, the mechanical mechanism of the stick and non-stick motions in the brake system can be intuitively presented, which may present a clue for brake system controls.



Bio-Sketch: Dr. Albert C.J. Luo, ASME Fellow, has been working on the theory and application of Nonlinear Dynamics and Mechanics for more than 20 years. Dr. Luo recently developed the theory of flow global transversality in nonlinear dynamical systems, which enhanced the understanding of the gradient system of Steven Smale (1962). Dr. Luo's theory of stochastic and resonant layers in nonlinear Hamiltonian systems systematically described the resonance mechanism of chaos. The local theory of discontinuous dynamical systems developed by Dr. Luo is instrumental in solving many difficult problems in science and engineering, such as gear transmission systems and control systems. In addition, Dr. Luo also developed an approximate plate theory, a large damage theory for anisotropic materials and a generalized fractal theory. Currently, Dr. Luo is conducting the experimental research on

accelerated fatigue and damage applied to the fatigue life evaluation of heavy-duty machines in aerospace and automobile industry. Dr. Luo has published over 130 peer-reviewed journal and conference papers, two monographs and one edited book on Nonlinear Dynamics. He has been an Editor for the journal *Communications in Nonlinear Science and Numerical Simulation* since 2002, an Editor for two book series on *Nonlinear Science and Complexity* (Elsevier) since 2004 and one book series on *Complexity, Nonlinearity and Chaos* (World Scientific) since 2007. He has been an Associate Editor for *ASME Journal of Computational and Nonlinear Dynamics* since 2006. He has been a member of editorial board for *IMECh E Part K Journal of Multi-body Dynamics* since 2002 and *Journal of Vibration and Control* since 2005. Dr. Luo also organized over 18 international symposiums and conferences on Dynamics and Control, including 14 ASME Symposiums and conferences. He served as the Technical Program Chair for ASME 2005 IDETC.