Appl Mech Rev vol 47, no 7, July 1994

PREFACE

Friction-induced vibration constitutes a serious problem in all machines and mechanisms undergoing sliding motions. This problem is encountered in many industrial applications including bearings, disc brake systems, electric motor drives, robot joints, wheel/rail mass transit systems running on a curved track, machine tool guideways, etc. While friction is desirable in some applications such as disc brakes, its effects which include vibration, chatter, squeal, and chaos are detrimental to the operation of machines. All contacts and interfaces have inherent nonlinear stiffness characteristics. Their mechanical properties are different from the bulk materials which make up the basic elements. Other nonlinearities arise due to the velocity dependence of frictional forces, various nonlinear damping mechanisms, and other geometric configurations of the systems and subsystems in which interfaces are imbedded. The interaction between interface behavior and the overall system dynamics lead to the possibility of rich and complex dynamic behaviors, only one of which may be relevant to a particular application. To unravel such problems will require multidisciplinary understanding and teamwork. For example, tribologists have traditionally been concerned with understanding the physics, chemistry and mechanics of basic friction, lubrication, and wear phenomena. The interactions between friction, contact mechanics, and overall system dynamics have received limited attention from tribologists. On the other hand, dynamicists and control engineers study stability and response characteristics of mechanical systems in which the interface forces interact with inertia, stiffness, and damping forces. Therefore, the friction and contact models that are used are often oversimplified or inappropriately represented. As problems of high frequency system dynamics and noise take on increasing technological importance in industrial components, it becomes necessary to establish stronger interdisciplinary links so that critical issues can be better defined and more rapid progress made to ultimately provide designers with better models and predictive tools.

This special issue includes four review articles addressing different issues of friction-induced vibration written by dynamists, tribologists, and control specialists. The first two articles are written by Professor Ibrahim. In the first part he addresses the mechanics of contact and friction in metal-metal and elastomer-metal contact surfaces. The main experimental and theoretical results pertaining to the dependence of friction on time, sliding velocity, normal load and temperature are reviewed. The second part deals with dynamics and modeling in different industrial applications. The fundamental theory of stick-slip is outlined with reference to constant and velocity-dependent friction. The problem of chatter and squeal is reviewed with reference to four main applications. These are sterntube bearing noise, wheel/rail squeal, disc brake systems, and machine tool systems. The third article is written by Dr Tworzydlo, *et al* who provide a comprehensive account of the numerical modeling of dynamic instability and vibrations of mechanical systems in the presence of friction. They adopted a typical pin-on-disk model with elastic connections to demonstrate the properties of the interface. Here the coupling between rotational and normal modes is considered as the primary mechanism causing self-excited vibrations. The last article is written by Professor Armstrong-Hélouvry, *et al* and is devoted to the role of friction in automatic control systems. It includes analytical tools and compensation methods for automatic control systems with friction.

It is hopeful that this special issue will stimulate further research activities in the area of friction induced vibration. The associate editors would like to thank the referees who participated in review process of these four articles

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