STUDY ON THE TACTILE PERCEPTION ON MATERIAL PROPERTIES DURING RECIPROCATING SLIDING AND TACTILE SIGNAL ACQUISITION

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Abstract

The stick-slip phenomenon generated between the sliding interfaces is one of the basic contents of friction-induced vibration study in tribology. It is expressed in the form of a jagged fluctuation with the sliding distance or time. In recent years, the research results show that human fingertip can sense the vibrational stimulates during the interaction with a surface. The microscopic viscoelastic model is established by the sliding friction microscopic visco-slip model can explain the mechanism of the friction induced vibration and the tactile perception of the contact system. Research on load, sliding speed, surface roughness and waviness of the material, adhesion characteristics of the friction pair, and the lubricating film can realize the identification of the material properties by the vibrational tactile signals. The research of such vibrational tactile perception has a significance theoretical and practical value for the development of robotic tactile sensors.

In the research of vibrational tactile perception on identification on material properties, basing on the interfacial frictional vibration mechanism, it is found that the material properties have a great influence on the stick-slip phenomenon in sliding friction. The mechanism of friction and vibration between the contact interfaces in the sliding motion of the fingertip was studied. Based on the adhesion friction and ratchet friction mechanism, the relationship between elastic modulus, hardness, normal load, roughness and dynamic/static friction coefficient and stick-slip motion is established for elastic contact and plastic contact in two contact models with and without consideration of the surface topography. The influence of surface topography on vibration signals was studied, the spectral integral variation

of the tactile vibration signal is positively correlated with the material hardness and surface roughness.

In the POD vibrational tactile perception tribology system device, the tactile sensor with a crossed-beam structure was designed by imitating the finger structure. The relationship between material properties and frictional force, normal load and vibration signals were studied in the time and frequency domain with various sliding velocity and normal load. A method for material property identification based on the spectral integral slope of vibration acceleration signal with velocity and normal load increasing is proposed. Experiments are carried out on various samples with different roughness and hardness. The tactile perception and material properties of complex friction

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