7th World Tribology Congress, WTC 2022
July 10-15, 2022, Lyon, France

Study on fiction anisotropy of CVT pulley induced by surface texture

Atsuta Harada[1)], Yu Nito[1)], Seiya Watanabe[2)], Shinya Sasaki[2)] *

[1)] Graduate school of Tokyo University of Science, 6-3-1 Niijyuku, Katsushika-ku, Tokyo, Japan
[2)] Tokyo University of Science, 6-3-1 Niijyuku, Katsushika-ku, Tokyo, Japan
*Corresponding author: s.sasaki@rs.tus.ac.jp

In order to implove torque transmission efficiency of belt type CVT, exhibition of friction anisotropy is required. In this study, two types of surface texture patterns were applied to actual CVT pulleys, and friction tests were performed. Test results suggest that surface textures applied to the pulleys inaduces friction anisotropy.

Keywords: CVT, surface texturing, friction anisotropy

1. Introduction

Belt type Continuous Variable Transmission(CVT) is a type of transmission applied to automobiles. Since the belt type CVT transmits torque by friction force, high friction force is required in the circumferential direction of the pulley in order to improve torque transmission efficiency. On the other hand, in the radial direction of the pulley, low friction force is required to reduce friction loss. Therefore, it is effective to exhibit the friction anisotropy which generate different friction force depending on the sliding direction for further improving the efficiency of belt type CVT. In this study, circlular or radial surface texturing is applied to actual CVT pulleys to exhibit friction anisotropy. In this presentation, we will discuss that the effect of surface taxtures on friction anisotropy based on the results of the friction coefficient between these pulleys and elements.

2. Methods

A sliding test was performed with a friction tester imitating the friction between a pully and a belt element of CVT. The schematic diagram of the friction tester is shown in Fig. 1. A vertical load and friction forces in circumferential and radial directions against the pully specimen are measured by a three-axis force sensor underneath the element specimen. In order to evaluate the friction anisotropy, the direction vector of friction force is controlled by changing the speed ratio of the pully and the element. Here, the circumferential direction and radial direction are defined as 0 deg and 90 deg, respectively. In this study, we changed the direction vector from 10 to 80 deg by 10 deg. Table 1 shows the experimental conditions.

We used three types of pulleys; non-textured, circle and radiation. The detail of the texture is shown in Fig. 2. An element specimen applied groove texture vertical to the reciprocating direction with a pitch of 200 μm and a width of 100 μm was used.

Table 1 Test conditions

Load [N]	100
Element Stroke [mm]	20
Speed in synthetic vector direction [mm/s]	30
Cycle [-]	50
Oil	CVTF(NS-3):10ml

3. Result&Discussion

Figure 3 shows the relationship between friction coefficient and direction of friction vector. The non-textured pulley shows friction anisotropy, which is due to the texture of the element. The circle texture shows lower friction coefficient than the non-textured analogue especially at larger sliding angles, while the radiation texture shows higher friction coefficient than that of non-textured. The slope in Fig. 3 was calculated with least squares method in order to evaluate the degree of anisotropy. Fig. 4 shows the value of slope of each pully specimen. The circle exhibited the largest anisotropy. In the presentation, we are going to discuss the detail of the effect of each texture on both pully and belt element on friction anisotropy.

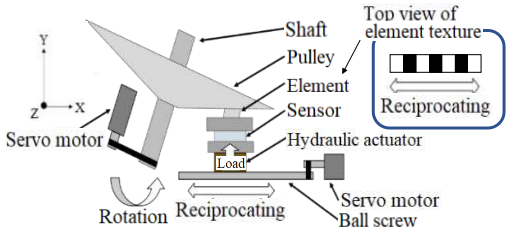

Fig. 1 Schematic diagram of CVT test rig

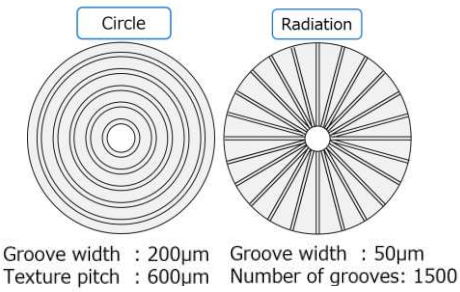

Fig. 2 Schematic diagram of textured pulleys

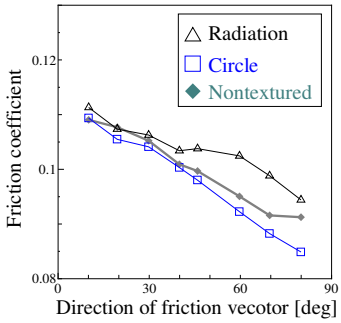

Fig. 3 Frictional properties of Speed 30mm/s in synthetic vector

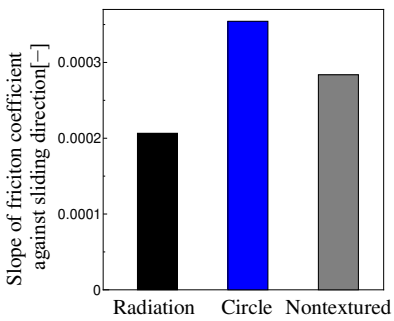

Fig. 4 Slope of Frictional properties by least squares method