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Torus Omnidirectional Driving Unit Mechanism Realized by Curved Crawler Belts

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Abstract—**In this research, omnidirectional crawler unit with the torus configuration is proposed. It is composed of two curved crawler belts whose inner and outer trajectories have the same length. The prototype is designed and developed. The basic motion of the prototype is confirmed experimentally.**

I. Introduction

In order to realize holonomic omnidirectional motion, there exist many commercial wheels which are based on small passive rotational wheels[1]. Some of them are similar to a crawler-like mechanism. However, these crawler-like mechanisms have many numbers of small passive rotational rollers, and are not generally capable of overcoming steps or ground discontinuities because of the very small diameter of the passive wheel. Therefore, we developed the omnidirectional crawler mechanism with circular cross section with the active rotational axis at the center of the crawler mechanism[2].

II. Basic Concept of Torus Omnidirectional Driving Unit Mechanism

The basic concept of the torus omnidirectional driving unit mechanism is shown in Fig. 1. By rotating the active central axis, the unit realizes smooth motions in arbitrary directions.

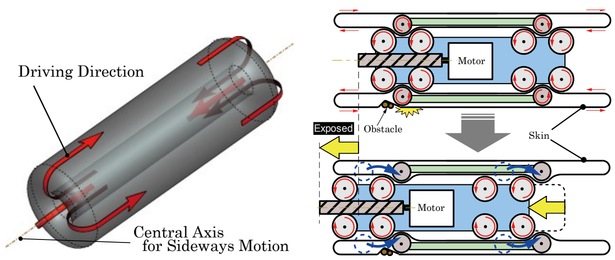

Figure 1. Conventional Torus Driving Mechanisms[3]

Conventional torus mechanisms have passive rollers, therefore if there is some obstacle, the roller can be moved from its initial position and the inner mechanism could be exposed like the right image of Fig. 1[3]. Therefore, the supporting part of the mechanism at the center must be fixed.

III. Prototype Model of the Unit Mechanism

The basic configuration of the prototype model is shown in Fig. 2. The mechanism to put the driving force to the belt is the tooth belt. By combining two curved units with the same center, the circular cross section is realized. Fig. 3(a) shows

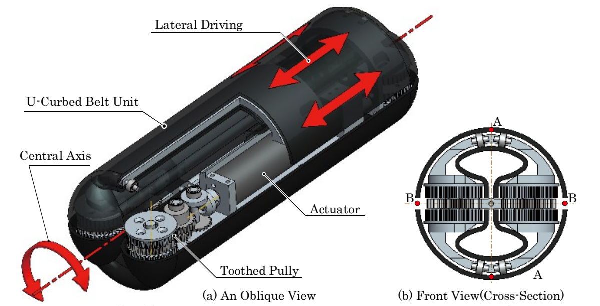

Figure 2. Basic Structure and Prototype Model with Torus Omnidirectional Driving Unit Mechanism

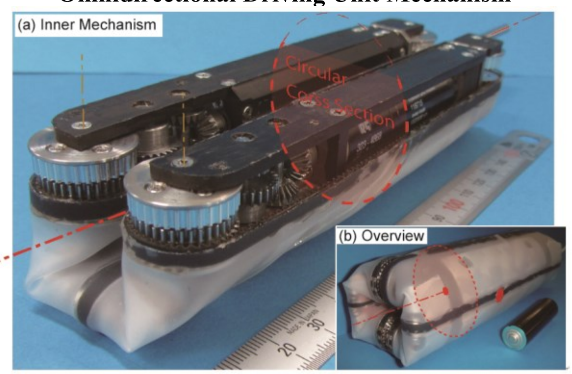

Figure 3. Torus Omnidirectional Driving Unit Mechanism

Table 1: Specifications of the Prototype Model

Length	172 (mm)
Diameter	50 (mm)
Weight (All)	402 (g)
Material of Crawler Belt	Silicon
Thickness of Crawler Belt	0.5 (mm)

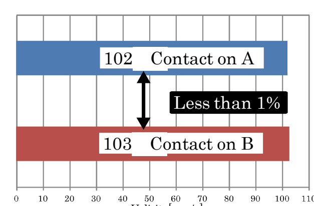

Figure 4. Velocities of the Crawler on Contact Points A and B

the inner mechanism and the whole configuration is shown in Fig. 3(b). Its specifications are shown in Table 1. In order to confirm the uniform velocity of the whole outer surface of the torus omnidirectional driving unit, we compared the velocities on the contact point A and B on the outer surface in Fig. 2. The result is shown in Fig. 4. There is not a significant difference between these two velocities, so the velocity at the whole surface can be considered almost the same and uniform.

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