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3D Modeling of Mechanical Transmissions for Base Translation of an Industrial Robot

This paper presents 2 chained mechanical transmissions used to obtain the base translation of an industrial robot: worm - worm gear transmission and motion screw - nut transmission. The kinematical scheme, the 3D models of the main parts of the mechanical transmissions and the 3D assembly model are shown. For modeling, CATIA V5 software was used.

Keywords*: modeling, mechanical transmission, industrial robot*

1. Introduction

Within the mechanical system of industrial robots, the motion from the motors to the robot's links can be transmitted in 2 ways: using mechanical transmissions and directly (direct drive). In the former case, to modify the parameters of motion given by the motor, different types of mechanical transmissions are used: gear, harmonic drive, motion screw - nut, worm - worm gear, etc. [3]. In the latter case, the motion is given directly by the motor, without mechanical transmissions.

2. Kinematical Scheme

The kinematical scheme of the mechanical transmissions is presented in fig. 1. The motion is transmitted from the electric motor to the worm - worm gear transmission and then to the motion screw - nut transmission. The nut is linked to a cylindrical joint to ensure only its translation and lock its rotation together with the screw. The transmission ratio for the worm – worm gear transmission is:

$$i_1 = \frac{\omega_m}{\omega_1} = \frac{400}{10} = 40\,, \qquad (1)$$

where: ω_m - the angular speed given by the electric motor;
ω_1 - the angular speed of the worm gear linked with the screw.

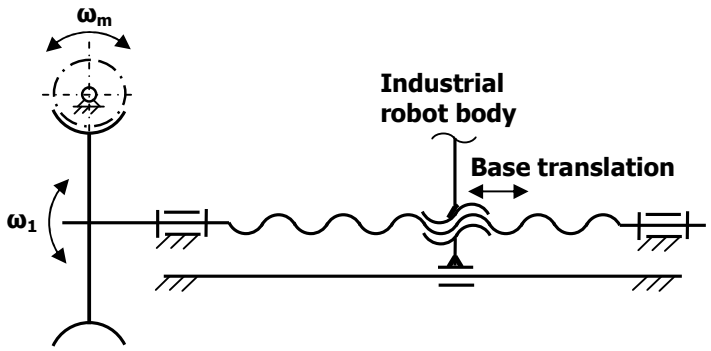
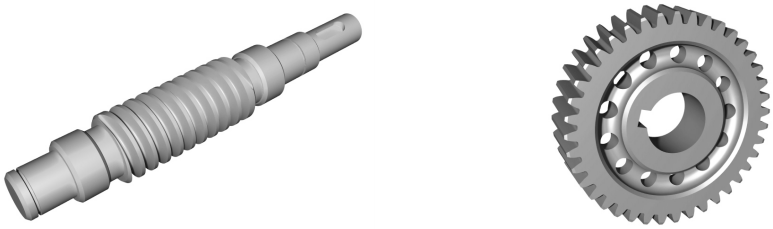


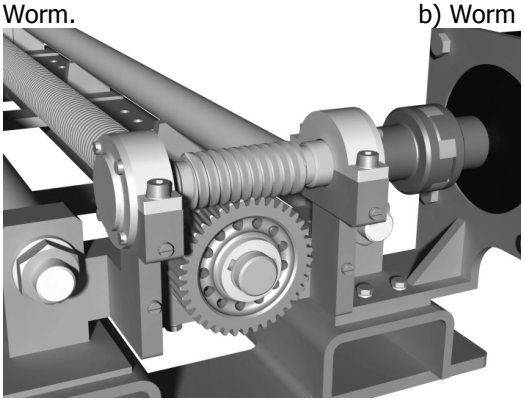
Figure 1. The kinematical scheme of the mechanical transmissions.

3. 3D Models

The 3D models of the worm - worm gear mechanical transmission parts are presented in fig. 2. All models were obtained using CATIA V5 software [1], [2], [4], [6].



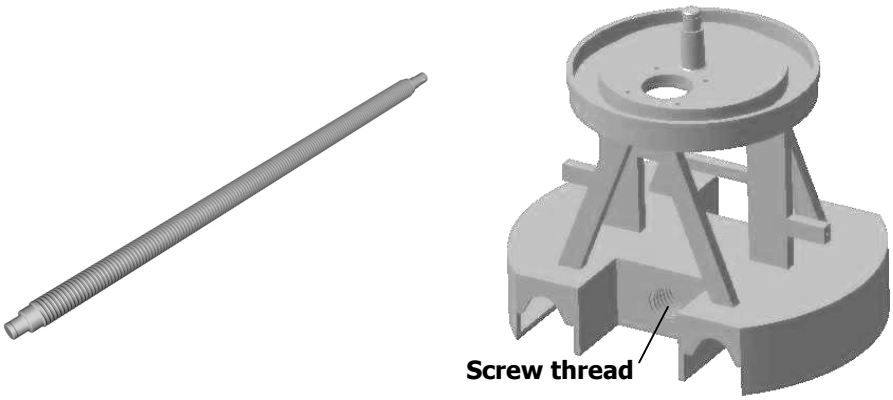
a) Worm. b) Worm gear.



c) Worm - worm gear mechanical transmission.

Figure 2. 3D models of the worm - worm gear mechanical transmission parts.

The 3D model of the motion screw - nut mechanical transmission parts are presented in fig. 2.



a) Motion screw.

b) Nut (screw thread realized in a robot's body part).

Figure 3. 3D models of the motion screw - nut mechanical transmission parts.

In fig. 4, the 3D model of the industrial robot base assembly is presented, with the electric motor, the 2 mechanical transmissions presented above and 2 guiding cylinders which lock the nut rotation.

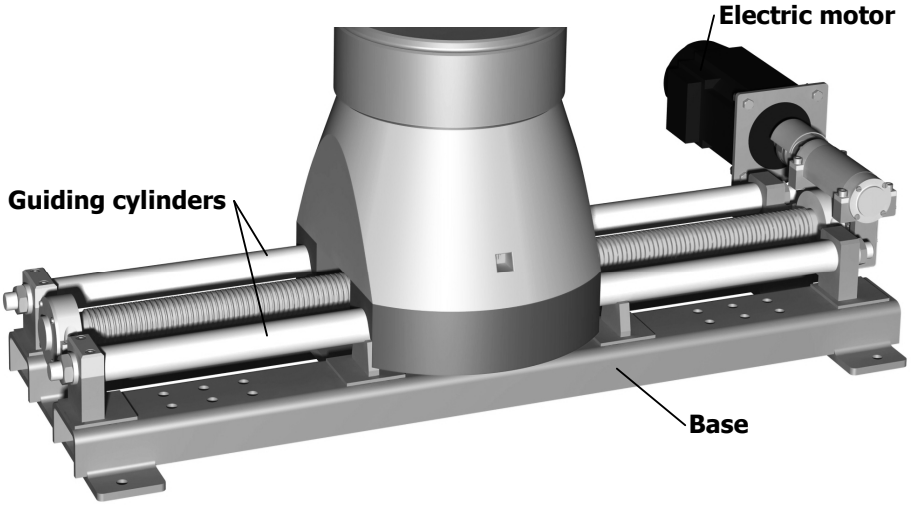


Figure 4. 3D model of the industrial robot base assembly.

4. Conclusions

3D modeling of mechanical transmissions for the base translation of an industrial robot was presented: worm - worm gear transmission and motion screw - nut transmission.

The modeling was realized for an existing source system, an educational industrial robot [5].

In the general case, any mechanical transmission can be modeled using CATIA V5 software in two stages: modeling the mechanical transmission parts and then assemblying them.

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[6] *** *CATIA V5 Online Documentation*.

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