Prototype and estimation for an ultrasonic motor using a transmission rod with a stator and a rotor at the both ends

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**Purpose**
- To develop an ultrasonic motor being able to use in special environment.
- To realize the ultrasonic motor, an ultrasonic motor using a transmission rod with a stator and a rotor at the both ends (ROD-USM) is proposed.

**Operation principle**
- Two orthogonal nonaxisymmetric modes – \(((1,1)) - ((1,1))'\) – of an annular plate is used.
- The vibrator is amounted at the rod end and the rotor is pressed at the other end.
- Two orthogonal bending vibrations are excited in the rod.
- Driving method for exciting two orthogonal modes.
- Mode simulation of the vibrator and the rod, and elliptical motion formed at the rotor side end.

**Design and estimation**
- Displacement of the rotor side end (y) changes by the mounting position of the stator.
- The mounting position of the shaft depends on the vibration of the shaft.
- Each displacement y becomes 2 times.

**Trial motor construction and measurement**
- Vibration velocity on the surfaces of rod and shaft
- Shaft vibrates in 7\textsuperscript{th} bending vibration mode.
- Shaft vibration amplitude relatively is small.

**Conclusions**
- A new structure of ultrasonic motor (ROD-USM) is proposed.
- Effective mounting positions of the vibrator and the shaft were proved.
- The motor operation of the new construction was confirmed.