

**CONFERENCE TITLE:** Smart Structures and Integrated Systems (ss03)

**CONFERENCE CHAIR:** Norman M. Wereley, Univ. of Maryland/College Park

**ABSTRACT TITLE:** Rotary ultrasonic motors actuated by flexural traveling wave operable at planetary and terrestrial conditions.

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**PRESENTATION:** Oral Presentation

**ABSTRACT TEXT:** Efficient miniature actuators that are compact, low mass, consume low power and can operate in harsh planetary conditions are needed to drive telerobotic devices and mechanisms of future NASA missions. Ultrasonic rotary motors have the potential to meet this NASA need and they are developed as actuators for miniature telerobotic applications. The technology that has emerged in commercial products requires rigorous analytical tools for effective design of such motors as well as enhancement to increase their durability. A finite element analytical model was developed to examine the excitation of flexural plate wave traveling in a rotary piezoelectrically actuated motor. The model incorporates the various components and the complex geometrical configuration to predict the excitation frequency and modal response of an annular stator. An effective USM was developed using the results of the model, where the details of the stator were used in the design including the teeth, piezoelectric crystals, stator geometry, etc. Parallel to this effort, USMs are made and incorporated into a robotic arm and their capability to operate at the environment of Mars is being studied. Issues that are associated with thermal cycling and cold start at different temperatures were investigated and the motor was demonstrated to sustain temperatures down to -150°C at vacuum at 16-mTorr for over 330-hours.

**KEY WORDS:** Ultrasonic Motors (USM), Stators and Rotors, Actuators, Active Materials, cryovac operation.

**BRIEF BIOGRAPHY:** Dr. Yoseph Bar-Cohen is a physicist with over 27 years experience in NDE, sensors, actuators and electroactive materials. He is the Jet Propulsion Lab (JPL) Resident NDE expert and the Group Leader for the NDE& Advanced Actuators (NDEAA) Technologies. Also, he is an Adjunct Professor at the Department of the Mechanical and Aerospace Engineering, the University of California, Los Angeles (UCLA), a Fellow of the American Society for NDT (ASNT) and Chair of the ASNT's Ultrasonic Committee. Dr. Bar-Cohen discovered the leaky Lamb waves and the polar backscattering in composite materials and pioneered their applications to NDE. He is the author of more than 135 publications, made numerous presentations at national and international symposia and holds many patents.