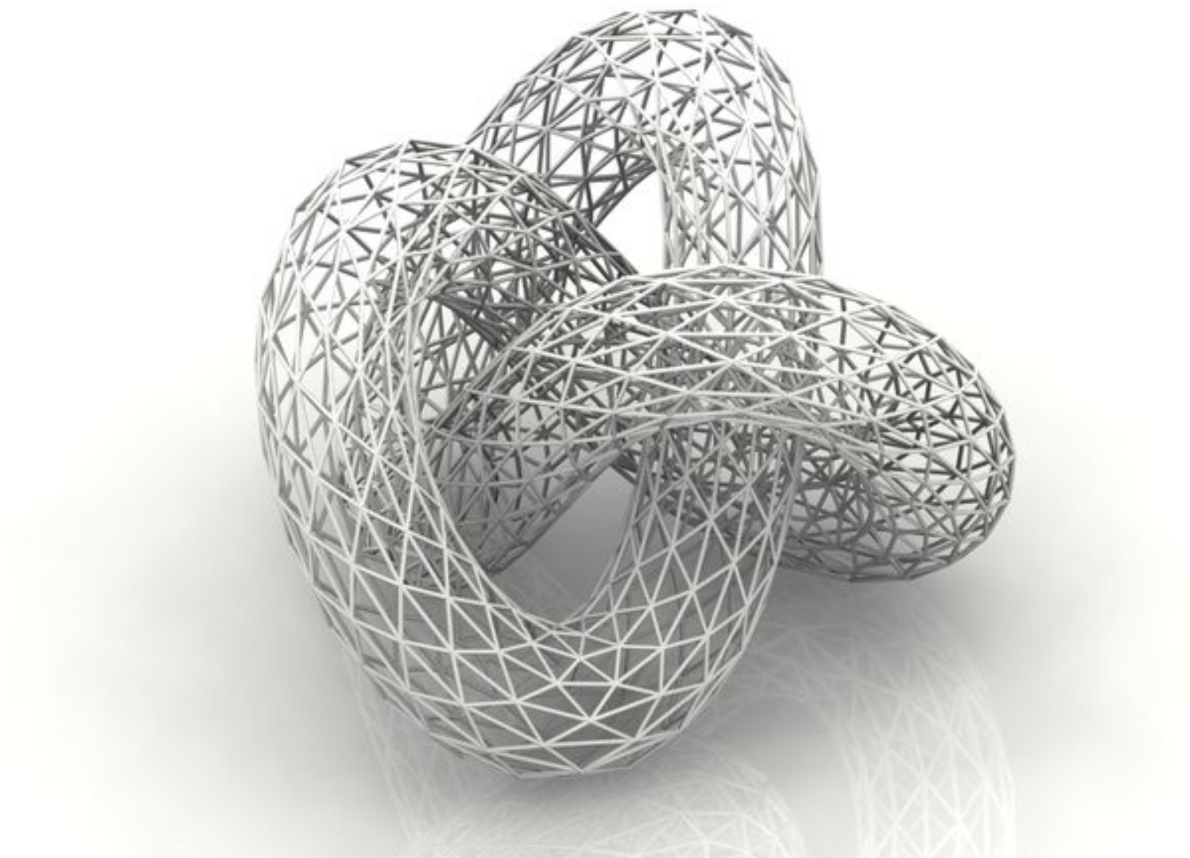
International Conference on Nonlinear Solid Mechanics

ICoNSoM2019



Abstract Book

June 16-19, 2019 | Palazzo Argiletum, Roma, Italy

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Plenary Lectures

Nonlinear Mechanics of Drilling
Balachandran B.

Surface Elasticity with Applications to Material Modelling at the Nano- and Micro-Scales
Eremeyev V. A.

Ten years of global digital volume correlation: What has been achieved?
Hild F.

Granular micromechanics: bridging grain interactions and continuum descriptions
Misra A.

On Seven- and Twelve-Parameter Shell Finite Elements and Non-Local Theories for Composite Structures
Reddy J. N.

Exploiting Global Dynamics to Unveil the Nonlinear Response and Actual Safety of Systems and Structures
Rega G.

Vibrations of Nonlinear Continua Subject to Combined Harmonic and Stochastic Forces: Linearization Approximations and Monte Carlo Simulations
Spanos P. D.

DYNAMIC RESPONSE OF FIVE-POLE PZT ACTUATOR APPLIED TO PALPATION DEVICE

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This study is devoted to development of a palpation device with haptic feedback based on a PZT actuator. Such devices are intended for telemedicine. In the previous research, we found that the PZT actuator is well-used for its high response, simple mechanism and low cost. Therefore our first prototype of palpation device was made of one PZT actuator, the haptic feedback mechanism, the control console and one probe on the slave side. When the button on the manipulator (master) side was pressed, the probe moved and interacted with an elastic sample. The force acting from the sample onto the probe was measured, and the PZT actuator on the master side produced a force proportional to this load and applied to the button. Thus, the haptic feedback was generated.

Actually, when pressing the button, the force feedback was a result of the PZT actuator force and the friction force. If the normal force between the PZT actuator and the slider increased, the friction force increased. Thus the force feedback was larger when pressing, but, on the other hand, larger friction force would decelerate the button going up or even would stop the button.

This study investigated a dynamic response of the PZT actuator for the following set of different normal force values: 8.7 N, 10.9 N, 13.1 N, 15.2 N. The working frequency was varied from 66.4 kHz to 76.4 kHz in 1 kHz increment. The resonance frequency 71.4 kHz was found. A linear reciprocating mechanism and a load cell were assembled with the button. The reciprocating mechanism was used to move the button up and down in the range of 2 mm. The load cell allowed measuring the force feedback. The results showed that, if the normal force is small, the force feedback in the resonance frequency was mostly obtained from the PZT actuator. The force feedback was quite small in the non-resonant frequency. The impact of the friction force increased, when the frequency moved away from the resonance frequency. When the normal force increased, the friction force in the non-resonant frequency increased obviously. With increasing the normal force the force of the PZT actuator decreased. Besides, the force feedback was relatively small when the PZT actuator was not activated.

For the palpation application, it is reasonable to use the PZT actuator with the smaller normal force and to assemble several actuators to enhance the force feedback.

Mini Symposium

MS-5 Dynamics and control of MEMS and NEMS

Dumitru Caruntu (University of Texas Rio Grande Valley) and Eihab Abdel-Rahman (Waterloo University, Canada)

Continuum level charge transport in electronic devices: A review on challenges and recent developments
Auf der Mar M.

Casimir effect on voltage amplitude response of parametric resonance of electrostatically actuated NEMS cantilever resonators
Caruntu, D.I, Reyes, C.A., Reyes, C.I.

Modeling Internal Resonance in 2D NEMS
More S. K., Samanta C., Naik A.K.