Seeks partner for commercializing a —

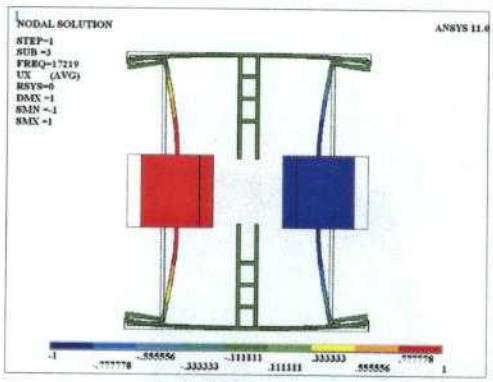
method for **Predicting Thermoelastic Damping** *in Micro/Nano-Mechanical Resonant Devices*

Old Dominion University seeks a partner(s) to license & commercialize a relatively simple but effective method for predicting Thermoelastic Damping (TED) in micro/nano-mechanical resonant devices.

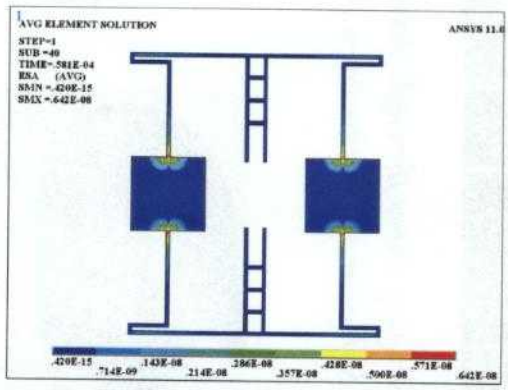
Applications:

Predict and optimize the Thermoelastic Damping & TED Distribution in Micro/Nano mechanical resonant devices, during the design process by utilizing insights provided by the Thermal-Energy method, for

- simple or complex structures, and
- made from *isotropic* and/or *anisotropic* materials.

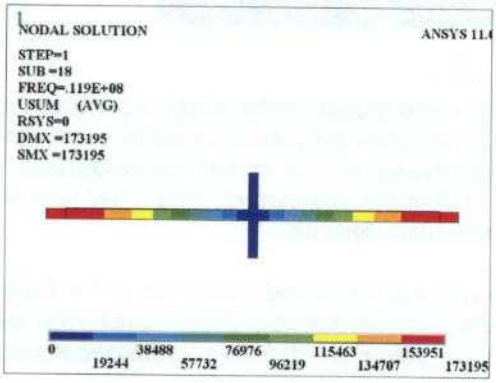


(a) Elastic vibration

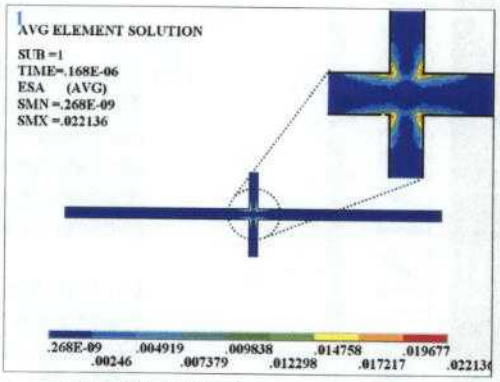


(b) TED Distribution

Simulated elastic vibration and TED distribution in a tuning fork gyroscope
(*Simulated Q_{TED} = 87,227, $Q_{measured}$ ~ 80,000*[1])



(a) Elastic vibration



(b) TED distribution

Simulated elastic vibration and TED distribution in a block resonator
(*simulated Q_{TED}=1,551,876, $Q_{measured}$~180,000*[2])

** *The simulated Q_{TED} is larger than the $Q_{measured}$, experimentally measured quality factor, because $Q_{measured}$, consists of other loss mechanisms ($1/Q_{measured}=1/Q_{TED}+1/Q_{other\text{-}loss}$),*

Refs 1. *Hao et al, IEEE Sensors 2006 Conference pp1333-1336*
2. *Mattila et al, Sensors and Actuators, A, Vol101 2002 pp1-9*

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Advantages:

- Predicted results show excellent correlation to measured results.
- Simple numerical implementation & no divergence problem, compared with Complex-frequency method.
- Reduction of development Time & Cost -- by predicting the mechanical quality factor related to TED, prior to manufacture.
- Improved designs with reduced thermoelastic damping.

Inventor of the
Thermal-Energy Method for Predicting Thermoelastic Damping in Micro/Nano-Mechanical Resonant Devices

Dr. Zhili Hao is an Assistant Professor of Mechanical Engineering at Old Dominion University.

Her research focuses on -------
The analytical, numerical and experimental study of complex multidisciplinary micromechanics that is critical for the performance of micro-devices and Microsystems, and the development of various micro-devices, such as high-precision gyroscopes, bulk-mode resonators, high-Q biosensors, torsion mirrors, as well as microfluidic devices.

Dr. Hao has over ten years of combined academic and industrial research experience in the MicroElectroMechanical Systems (MEMS) field. Currently, she holds a US patent on Miniature Thermoacoustic Cooler, # 7,017,351.

She is a member of American Society of Mechanical Engineers (ASME) and Institute of Electrical & Electronics Engineers (IEEE).

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