

## Product Design Case Study (University of Puget Sound – Musical Drumhead)

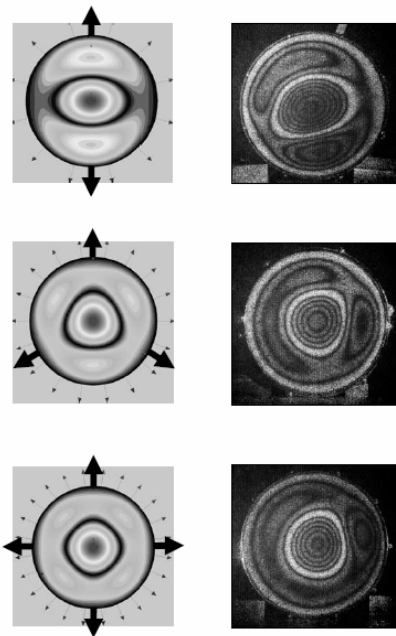


The Physics Department of the University of Puget Sound ([www.pugetsound.edu](http://www.pugetsound.edu)) of Tacoma WA, conducted a research study of the behavior of normal modes on a musical drumhead under non-uniform tension. An optical setup was used (electronic speckle-pattern interferometer) to record images of the mode shapes and to determine their corresponding frequencies. The idea was to see how these frequencies and shapes change as the tension in the drumhead is altered from uniform. (There are analytical solutions for the uniform tension case.)

As there is no analytical solution to the drumhead problem when the tension is non-uniform, the NEi Fusion and NEi Nastran FEA software were used to see how the frequencies and mode shapes would respond to particular types of non-uniform forces applied around the boundary (equivalent to tightening the tuning lugs of a drum in a non-uniform manner).

The main problem was to set up a circular membrane problem with a fixed perimeter and then apply unequal radial forces around the perimeter. Then the pre-stress normal modes technique was used to get the mode shapes and frequencies.

The resulting model worked very well and was useful for comparison with the experimental data. It was particularly good that the perimeter forces were applied in different symmetric ways, i.e. extra force at two, three, or four, etc. equally spaced locations around the perimeter. This allowed the researcher to relate the symmetry of the applied tension perturbation to the resulting frequency splitting of certain degenerate modes.



**NEi Software, Inc.** is aggressively focused on commitment to the customer. Detailed documentation, customized on-site training, and comprehensive technical support ensures that you will see immediate return on your investment.

**For more information about our company or our products, please contact:**

**Headquarters:**

**NEi Software, Inc.**

5555 Garden Grove Blvd., Suite 300

Westminster, CA 92683-1886

USA

Phone: +1.714.899.1220

Fax: +1.714.899.1369

Email: [info@neisoftware.com](mailto:info@neisoftware.com)

Website: [www.NEiSoftware.com](http://www.NEiSoftware.com)

**Europe:**

**NEi Software EMEA Office**

The Old Barrel Store

Draymans Lane, Marlow

Buckinghamshire, SL7 2FF

United Kingdom

Phone: +44.0.1628.400.645

Fax: +44.0.1628.891.701

E-mail: [emea@neisoftware.com](mailto:emea@neisoftware.com)

Website: [www.NEiSoftware.com/emea](http://www.NEiSoftware.com/emea)

**Asia:**

**NEi Software Asia Office**

Shinjuku Park Tower

N30th Floor 3-7-1 Nishi-Shinjuku

Shinjuku-ku, Tokyo, 163-1030

Japan

Phone: +81.03.5326.3062

Fax: +81.03.5326.3001

E-mail: [asia@neisoftware.com](mailto:asia@neisoftware.com)



NEi Nastran *for Windows*  
From NEi Software, Inc.