



Professor P. Frank Pai

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Mechanics and Aerospace Engineering
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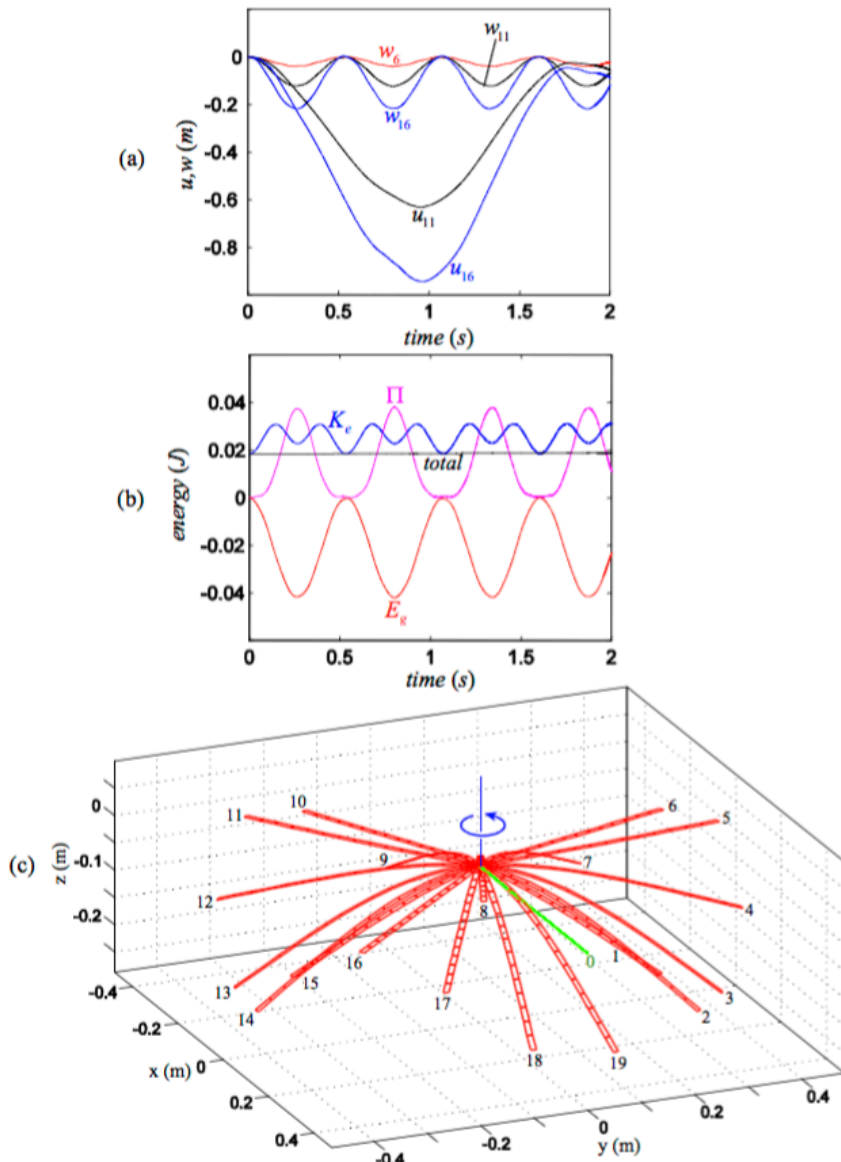


Figure 5. Finite element analysis of a rotating beam: (a) displacements u and w , (b) different energies, and (c) deformed geometries at different times.

From: P. Frank Pai, "Three geometrically exact beam theories for analysis of highly flexible 1-D structures, 52nd AIAA Structures, Structural Dynamics and Materials Conference, AIAA Paper 2011-1854, 4-7 April, Denver, Colorado, 2011

Biography:

P. Frank Pai is a C.W. LaPierre Professor in the [Mechanical and Aerospace Engineering Department](#) at the University of Missouri. Having joined Missouri after working three years at North Carolina A&T State University, Pai developed the MU Structural Mechanics and Controls Laboratory for advanced mechanical and aerospace structure research. Pai has received funding from the National Science Foundation, NASA Headquarters, NASA Langley Research Center, NASA Marshall Space Flight Center, the U.S. Army Research Office, the Air Force Office of Scientific Research, Sandia National Laboratories, National Renewable Energy Laboratory and Raytheon E-Systems. He is a registered professional engineer in North Carolina.

Research Interests:

Design of highly flexible deployable/inflatable structures; Structural damage inspection; Nonlinear dynamics; Finite element methods; Applications of smart materials

Education:

Ph.D Virginia Polytechnic Institute and State University
M.S. National Taiwan University

Selected Publications:**Book:**

Ali H. Nayfeh and P. Frank Pai, Linear and Nonlinear Structural Mechanics, John Wiley & Sons, 2008 763 pages
Pai, P. F., Highly Flexible Structures: Modeling, Computation, and Experimentation, AIAA Education Series, 2007

Journal Articles:

P. F. Pai and A. H. Nayfeh, "Nonlinear Flexural-Flexural-Torsional Dynamics of Metallic and Composite Beams," SECTAM XV. 1990 Southeastern Conference on Theoretical and Applied Mechanics, Atlanta, GA, March 22-23, 1990.
A. H. Nayfeh and P. F. Pai, "Nonlinear Vibrations of a Cantilever Composite Beam Under Planar Harmonic Base Excitation," Third Technical Workshop on Dynamics and Aeroelastic Stability Modeling of Rotorcraft Systems, Duke University, Durham, NC, March 12-14, 1990.
P. F. Pai and A. H. Nayfeh, "Three-Dimensional Nonlinear Vibrations of Beams," 62nd Shock and Vibration Symposium, Springfield, VA, October 29-31, 1991.
Pai, P. F. and Nayfeh, A. H. (1991). "A nonlinear composite plate theory." Nonlinear Dyn., 2(6), 445–477.
Pai, P. F. and Nayfeh, A. H. (1992). "A nonlinear composite beam theory." Nonlinear Dyn., 3(4), 273–303.
Pai, P. F. and Nayfeh, A. H. (1992). A Nonlinear Composite Shell Theory. Nonlinear Dynamics, 3:431–463.
Pai, P. F. and Nayfeh, A. H. Fully nonlinear model of cables. AIAA Journal, 30, 2993–2996 (1992).
K. Oh, P. F. Pai, A. H. Nayfeh, and M. L. Fripp, "Response of an Adaptive Structure to a Broadband Excitation" CCMS/CASS Review, VPI&SU, Blacksburg, VA, March 22-24, 1992.
K. Oh, A. H. Nayfeh, and P. F. Pai. "Control of the Resonant Response of a Cantilever Plate Using PVDF Films as the Sensor/Actuator System: An Experimental Study," Recent Advances in Adaptive and Sensory Materials and their Applications, VPI&SU. Blacksburg, VA, April 27-29, 1992.
P.F. Pai, A.H. Nayfeh, K. Oh and D.T. Mook 1993 Journal of Solids and Structures 30, 1603-1630. A Refined Nonlinear Model of Piezoelectric Plates.
P. F. Pai and A. H. Nayfeh, "A Geometrically-Exact Beam Theory Accounting for Warpings and 3-D Stress

Effects," Fourth Conference on Nonlinear Vibrations, Stability, and Dynamics of Structures and Mechanisms, VPI&SU, Blacksburg, VA, June 7-11, 1992.

Pai, P. F. and Nayfeh, A. H. A fully nonlinear theory of curved and twisted composite rotor blades accounting for warpings and three-dimensional stress effects. *International Journal of Solids and Structures*, 31, 1309–1340 (1994).

Pai, P. F. and Nayfeh, A. H. A unified nonlinear formulation for plate and shell theories. *Nonlinear Dynamics*, 6, 459–500 (1994).

Pai, P. F. and Palazotto, A. N. Polar decomposition theory in nonlinear analyses of solids and structures. *Journal of Engineering Mechanics*, 121, 568–581 (1995).

Pai, P. F. and Palazotto, A. N. Nonlinear displacement-based finite-element analyses of composite shells—A new total Lagrangian formulation. *International Journal of Solids and Structures*, 32, 3047–3073 (1995).

Pai, P. F. A new look at shear correction factors and warping functions of anisotropic laminates. *International Journal of Solids and Structures*, 32, 2295–2313 (1995).

P.F. Pai, Palazotto, Large-deformation analysis of flexible beams. *Int. J. Solids Struct.* 33 (9) (1996) 1335-1353.

Pai, P. F., Wen, B., Schulz, M. J. and Naser, A. S. Nonlinear vibration suppression of cantilever beams using bi-moments induced by PZT actuators. AIAA-97-1357-CP, (1997).

P.F. Pai, A. Palazotto, J.M. Greer, 'Polar decomposition and appropriate strains and stress for nonlinear structural analysis', *Computer & Structures*, 66, pp. 823-840, (1998).

P. Frank Pai, Amir H. Naghshineh-Pour, Mark J. Schulz and Jaycee Chung, "Dynamic characteristics and buckling strength of composite-repaired aluminum plates", *Finite Elements in Analysis and Design*, Vol. 28, No. 3, January 1998, pp. 255-275, doi:10.1016/S0168-874X(97)00039-5

P.F. Pai and M.J. Schulz (2000). Modeling of highly flexible structures. *J. Spacecraft*, 37(3), 419–421.

Pai, P.F. and Palazotto, A.N., A higher-order sandwich plate theory accounting for 3-D stresses. *Int J. Sol. Struct*, 2001. 38: p. 5045-5062.

P. Frank Pai, "Total-Lagrangian Formulation and Finite-Element Analysis of Highly Flexible Plates and Shells", *Mathematics and Mechanics of Solids*, April 2007, vol. 12, no. 2, pp. 213-250

P. Frank Pai, "Three geometrically exact beam theories for analysis of highly flexible 1-D structures, 52nd AIAA Structures, Structural Dynamics and Materials Conference, AIAA Paper 2011-1854, 4-7 April, Denver, Colorado, 2011

P. Frank Pai, Robert D. Chapman and Zaichun Feng, "Geometrically exact displacement-based shell theory", *Thin-Walled Structures*, Vol. 70, pp 1-18, September 2013

P. Frank Pai, "Problems in geometrically exact modeling of highly flexible beams", *Thin-Walled Structures*, Vol. 76, pp 65-76, March 2014