

Title**Linear and Nonlinear Modelling/Dynamics of L-Shaped Beam –
A Simple ‘Composite’ Elastic Structure**

by Dr. Fotios Georgiadis or Georgiade

Abstract

Since the 1960s, the dynamics of L-shaped coupled beams has been of interest because of their relative structural simplicity. It is among the simplest ‘composite’ elastic structures. It is derived all the equations of motion of an L-Shaped beam structure, and it is showed the importance of rotary inertia terms. The equations are decoupled in two motions, namely the in-plane bending and out-of-plane bending with torsion. A theoretical and numerical modal analysis has been performed and it is examined the effect of the orientation of the secondary beam (oriented in two ways) and also the shear effects. Parametric study of natural frequencies for various parameters of the L-Shaped beam showed stiffening and softening effects. Also in case that the length of secondary beam is less than 10% of the length of the primary beam, then the system behaves like cantilever beam with tip mass. Modelling of geometric nonlinearities indicates that the in-plane with out-of-plane motions are coupled together and has to be considered both planes even in examining up to 2nd order nonlinearities. Noted, so far in the literature of the L-Shaped beam structures with geometric nonlinearities the out-of-plane motions has been neglected. Although the two elastic beams are connected, the equations of motion form a self-adjoint system, therefore the projection of the dynamics in the infinite basis of the underlying linear system, lead to the modal equations with only nonlinear coupling and then well-known dimension reduction methods can be applied e.g. center manifolds. This work, paves the way for examination of dynamics in case of geometric nonlinearities of L-Shaped Beam structures, since it is almost impossible using commercial finite element software to perform nonlinear dynamic analysis e.g. the determination of Nonlinear Normal Modes as periodic orbits of millions of DOFs. Also, this work paves the way for analytical modelling and dynamic analysis of more complicated elastic structures e.g. a full airplane model.

Dr. Fotios Georgiadis or Georgiades -CV

Dr. Georgiadis, since May 2013 is a Senior Lecturer in Mechanical Engineering at the Lincoln School of Engineering as Senior Lecturer in Mechanical Engineering. Dr. Georgiadis is a mechanical engineer from the Technological Institute of Piraeus (Greece). He obtained his M.Sc. in Structural Integrity from Sheffield University (UK) and his PhD in Applied Mechanics from NTUA (Greece) specialized in Nonlinear Vibrations. Dr. Georgiadis research field is Modelling and Examining Linear and Nonlinear Dynamics of Mechanical Structures.

Dr. Georgiadis worked from November 2010 until October 2012, as Assist. Prof.-Research Fellow (Marie Curie) to provide expertise for building Centre of Excellence at Lublin University of Technology (CEMCAST project) in dynamics of composite structures for airspace applications. In 2009, Dr. Georgiadis worked as Marie Curie Fellow for ten months in ASAP project, at Eötvös Loránd Geophysical Institute for determination of earth properties through vibration measurements. Dr. Georgiadis two years Post-doctoral experience gained at University of Liege (Belgium) in Aerospace and Mech. Eng. Dept. in collaboration with GaTech (Atlanta-USA, three months staying in 2007) by doing research in nonlinear vibrations of bladed disk assemblies.

Dr. Georgiadis research outcome is extended to 14 refereed journal articles and 14 refereed conference articles and he served as chairman in 3 International Conferences/Workshops. In January 2017, Dr. Georgiadis joined the editorial board of Journal of Vibration Testing and System Dynamics (JVTSD) from L&H Scientific Publishing. In February 2011, Dr. Georgiadis was nominated as Member of Polish Academy of Science in Committee of Nonlinear Sciences for the years 2011-2014. He served as referee in sixteen International journals (Communication of Nonlinear Science and numerical Simulations, Journal of Nonlinear Science, Journal of Nonlinear Dynamics, Journal of Sound and Vibration, Meccanica, Journal of Nonlinear Mechanics, Journal of Applied Mechanics (ASME), European Journal of Mechanics /A Solids, Mechanics Research Communications, Mechanism and Machine Theory, etc, in most of them is still serving) relative to Structural Dynamics. Dr. Georgiadis has been invited eight times to give specialist lectures and has also participated in six workshops. Dr. Georgiadis has been awarded "Scientific Instruments Makers Scholarship" of the Worshipful Company (London). While he was doing his PhD in National Technical University of Athens he worked as an engineer for five years in a number of engineering companies, among them was Technip S.A. an international company.