Optimal Placement of Piezoelectric Plates to Control Multimode Vibrations of Rotating Beam

Fabio Botta[1], Daniele Dini[2], Stefano Gentili[1], Giovanni Cerri[1]

[1]Dipartimento di Ingegneria Meccanica e Industriale, Università degli Studi di Roma Tre, Roma, Italy
[2]Department of Mechanical Engineering, Imperial College London, London, United Kingdom

Abstract

Turbomachines blades are forced by a load resulting from the interaction with the fluid. The consequent vibrations, and the associated fatigue phenomena, can give catastrophic failures and the reduction of the blades life []. It could be increased if damping system are used. The piezoelectric materials has received considerable attention by many researcher for their potential application in the passive and active vibrations control. It is well know the relation between electrical and mechanical quantities: a strain field occurs when an electric field is applied, and vice-versa. In compliance with this effects the active blades vibrations control could be realized by the application on blade of piezoelectric plates; so that vibrations induced by the external load can be reduced if the mechanical action of PZT is in opposition respect of the external load action. In order to obtain the maximum vibration reduction research focuses on the characterization of the optimal placement of PZT on blade; in fact the position that realized the maximum PZT action depends on the composition of the spectrum load, because correlated with the maximum PZT mechanical work on blade[].The Optimal placement issue has been analytically solved for non-rotary beam and a single mode spectrum load[]; the authors have solved the same problem by considering a multi-mode spectrum load [], and have validated via FEM and experimentally the theoretical solution obtained[].