UNIVERSITÀ DEGLI STUDI DI BERGAMO

Dipartimento di Ingegneria

Lunedì 28 Ottobre 2013 - Aula 7, ore 15:00

Prof. Maryam Ghandchi Tehrani

UNIVERSITY OF Southampton
Institute of Sound and Vibration Research

Visiting Professor presso la sede di Dalmine nel periodo 17-31 Ottobre 2013
nell'ambito dell'iniziativa
"Progetto Italy®, Action 3: Grants for Visiting Professor and Scholar"
terrà il seminario dal titolo

Energy Harvesting Methods for Nonlinear Control Devices in Structural Dynamics

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SEMINAR

Energy Harvesting Methods for Nonlinear Control Devices in Structural Dynamics

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28 October 2013

The problem of energy harvesting using nonlinear control is considered for this presentation. First, energy harvesting using a linear mechanical oscillator is investigated and the harvested power and the throw are obtained both numerically and analytically. The application of linear harvesters is demonstrated on the energy harvesting from train vibrations [1]. The harvested energy for example could be used to power up the sensors that are mounted on the rail track for the purpose of structural health monitoring. Then the application of semi-active control for power harvesting using an electro-mechanical energy harvester is considered. Two semi-active control strategies are proposed in the form of a time-periodic damper and a nonlinear cubic damper. For the periodic time-varying damper the average harvested power and the throw are obtained based on the harmonic balance method. The semi-active periodic time-varying damper is optimised to maximise the harvested power. The performance of the optimum semi-active periodic damper is compared with the optimum passive and semi-active on-off model at a particular frequency. It is demonstrated that the periodic time-varying damper can significantly increase the harvested power at all frequencies of interest [2]. For the nonlinear damper, the harvested power and the throw are derived using the concept of the describing function. The results are compared with the linear harvester. It is demonstrated that the nonlinear damper can significantly increase the harvested power at resonance when driven at its maximum amplitude [3]. This makes the semi-active nonlinear damper very attractive for practical applications.

Keywords: *Energy Harvesting, Nonlinear and Semi-active Dampers, Control Strategy, Structural Health Monitoring.*

References

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[2] F. Di Monaco, M. Ghandchi Tehrani, S.J. Elliott, E. Bonisoli, M. Tornincasa, Energy harvesting using semi-active control, *Journal of Sound ad Vibration*, Vol. 332, No. 23, doi:10.1016/j.jsv.2013.06.005, pp. 6033–6043, 2013.

[3] M. Ghandchi Tehrani, S.J. Elliott, Extending the dynamic range of an energy harvester using nonlinear damping, *Journal of Sound ad Vibration*, in press, 2013.