

Fault Localization in Ring Type Structures with a Second-Order Output Spectrum based method

Q. K. Li and X. J. Jing*

Department of Mechanical Engineering
The Hong Kong Polytechnic University
Hung Hom, Kowloon, Hong Kong, China

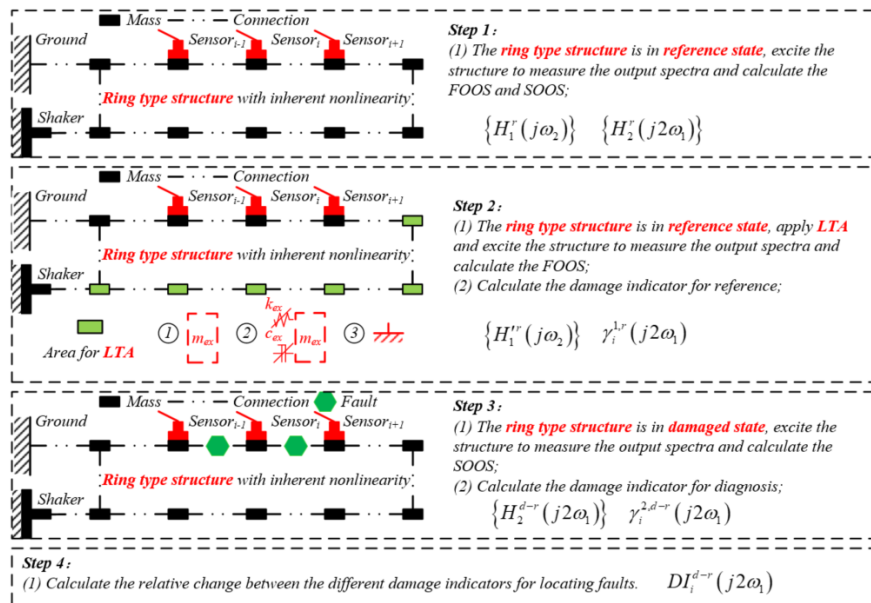
* Email: xingjian.jing@polyu.edu.hk, web page: <https://www.polyu.edu.hk/web/en/home/index.html>

ABSTRACT

In order to localize nonlinear faults in ring type structures, a novel second-order output spectrum (SOOS) based method is proposed in this paper. Along the vibration transmission paths in complex structures, the ring type structures are found and labeled by the sensor chains. The ring type multiple degree-of-freedom (MDOF) model and Volterra series are utilized to describe the nonlinear behaviour of these ring type structures with nonlinear faults and inherent nonlinearity. With harmonic excitation analysis and local tuning approach (LTA), the properties of the SOOS of nonlinear ring type structure are derived and analyzed. Based on these properties, a novel SOOS based method with a local damage index is proposed for nonlinear fault localization. In the numerical study, the results of comparison between previous and novel methods demonstrate that the proposed local damage index can provide more correct information of fault positions, and hence the novel method can be used for multiple fault diagnosis in ring type structure with inherent nonlinearity.

Keywords: Ring type; Damage indicator; Fault localization; Nonlinear output spectrum

FLOW CHAT OF METHOD



REFERENCES

- [1] D. J. Ewins, Modal testing: theory, practice and application, Research studies Pre, 2nd ed., 978-0863802188, 2000.
- [2] T. J. Johnson and D. E. Adams, "Transmissibility as a differential indicator of structural damage," Journal of Vibration and Acoustics, 124(4): 634-641, 2002.
- [3] X. J. Jing, "Nonlinear characteristic output spectrum for nonlinear analysis and design," IEEE/ASME Trans. Mech., 19: 171-183, 2014.
- [4] Q. K. Li and X. J. Jing, "A second-order output spectrum approach for fault detection of bolt loosening in a satellite-like structure with a sensor chain," Nonlinear Dyn, 89: 587-60, 2017.