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# Modal Macro-Strain Flexibility Methods for Damage Localization In Flexural Structures Using Long-Gage FBG Sensors, Structural Control And Health Monitoring

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## Abstract

Modal flexibility is a robust and promising damage index for constructed facilities. However, the classical-flexibility methods are still unable to provide the required accuracy and reliability for damage localization due to their low sensitivity to small and multiple damages, and high sensitivity to measurement noise. In most cases, the modal parameters of the structures in the healthy state are required as baseline. On the other hand, the recent major advances in structural dynamics and mechanical vibration measurements have provided the opportunity to exploit more reliable modal parameters for damage identification. This paper presents modal macro-strain (MMS) flexibility methods to detect and locate multiple damages in elastic structures on the basis of dynamic distributed strain measurements from long-gage fiber Bragg grating sensors. Through analytical and experimental investigations, the MMS flexibility and its curvature have been validated as reliable indices to accurately localize less severe practical damages from few measurable modes with or without baseline information. The proposed damage indices are promising alternatives to the classical approach for civil structures where mode truncation and measurement errors are inevitable. 

**Keywords:** damage identification; dynamic distributed strain; modal macro-strain flexibility methods; long-gage FBG sensors; measurement noise; structural health monitoring