# On the Benefit of Including Modal Strains in FE Model Updating for Damage Assessment

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## Abstract

FE model updating has mostly been performed relying upon natural frequencies and mode shapes. These modal parameters only provide global information about the structure, which leads to important uncertainties. The recent development of fiber optic strain sensors has made it possible to include modal strains in FE model updating. In this paper, it is investigated how including modal strains in FE model updating allows complementing the global information on natural frequencies and mode shapes by the local information in modal strains. Including modal strains can be of major benefit for identification of local damage. With the additional information obtained using modal strains, local uncertainties in FE model updating can be effectively reduced. The benefit of including modal strains in FE model updating is illustrated using modal data from numerical simulations on a reinforced concrete (RC) beam.

**Keywords:** modal strains; FE model updating; uncertainty quantification; bayesian inversion; complementary information.

## 1 Introduction

It has since long been recognized that modal curvatures or strains are more sensitive to local damage, therefore, including modal strains in FE model updating can overcome the limitations in FE model updating resulting from the use of natural frequencies and modal displacements only. The recent development of fiber optic strain sensors has made it possible to use directly measured modal strains for FE model updating. Recently developed signal processing algorithms allow standard fiber-optic Bragg gratings (FBG) capturing the very low strain levels (sub-microstrain) occurring under ambient excitation in operational conditions. The use of modal strains in FE model updating has already been explored by several authors [1,2]. The benefit of including strains in terms of the additional information they provide, is yet to be explored, however.

In this paper, modal strains are included in FE model updating for damage assessment. A Bayesian framework is adopted to investigate how the additional information provided by modal strains helps to detect

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