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Planar crack identification via the Reciprocity Gap method with polynomial reconstruction

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In the framework of the non-destructive control of mechanical components, the question of the identification of internal macroscopical cracks from indirect measurements is relevant. In this contribution, we focus on the identification of cracks from the measurement of the displacement at the boundary of a domain submitted to a known mechanical load. Note that this problem can also be posed in term of electrostatic or thermal measurements.

This problem has been addressed in the past by many authors. In this contribution, we will focus on the Reciprocity Gap method [2, 3, 1]. The hypothesis is made that the crack is contained within a plane. Under that condition, a set of explicit formulae allows to determine the coordinates of this plane. After that, it is possible to compute, via the reciprocity gap formula, the displacement gap over this plane thanks to the use of well-chosen test-functions.

The aim of this work is first to test numerically the method that was proposed in [3] and only partially numerically tested in [1]. Both 2D and 3D test-cases are provided. These numerical tests highlight the limitations of the Fourier test-functions originally proposed.

In a second part, we propose polynomial test-functions that make it possible to perform a good quality reconstruction. We investigate the numerical behavior of the method for different shapes of the crack (connex or not, convex or not), geometries of the studied domain and noise on the measurements.

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