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The non-destructive inspection is a key-problem in many industrial processes since the detection of defects or cracks in the products is mandatory. Many tomographic approaches that have been proposed are based on the use of interrogating microwaves and their effectiveness in inspecting dielectric or conductive materials has been demonstrated. In general, a NDT/NDE problem solved through an inverse scattering technique is still ill-conditioned and non-linear. However, unlike standard microwave imaging problems where a complete image of the unknown investigation domain is required, a lot of *a-priori* information on the scenario under test (the industrial product) is available. In this framework, *Caorsi et al.* proposed an optimization technique (FGA) [1], where a reduction of the number of problem unknowns was achieved by exploiting such an *a-priori* information about the inspected geometry. As a matter of fact, a non-destructive inspection is aimed at detecting an unknown defect inside a known unperturbed host medium lying on a known background. Starting from this assumption, the *a-priori* information on the unperturbed structure was exploited by means of a suitable Genetic Algorithm (GA). As a consequence, the inverse scattering problem in hand was significantly simplified since the unknowns was reduced to an array of geometric parameters of the defect: the position of the defect, its size and orientation, and its electromagnetic properties.

Successively, a further improvement was achieved employing the inhomogeneous Green's function [2], which allows a reduction of the region of interest to the area occupied by the crack without increasing the computational burden of the detection process. Thanks to this formulation, the developed approach (called Inhomogeneous Green's Approach – IGA) obtained a further reduction of the computational burden as well as more accurate reconstructions.

Even though non-negligible results were obtained, they were limited to simplified geometries where a single defect was present. In order to address more realistic problems, this paper presents a new methodology based on the original IGA and able to deal with problems characterized by more complex geometries in comparison to the single-crack configurations so far considered. Towards this end, two different strategies have been developed. More in detail, the multicrack detection is performed by means of two different minimization strategies, both based on the inhomogeneous Green's function [2]. The former is characterized by a set of parallel GA sub-processes, each of them concerned with trial solutions encoding the same number of crack. Successively, a second optimization is carried out in order to select the best solution among the different crack-length optimal solutions given by each of the GA sub-processes.

On the other hand, the second strategy is based on a single GA process where multiple-length chromosomes are defined in order to code contemporarily different solutions characterized by a different number of defects. Such an approach allows a considerable computational saving, but it required the definition of a new complete class of genetic operators.

As far as the numerical validation is concerned, several realistic test cases have been taken into account and the obtained results demonstrate the feasibility as well as the effectiveness of the proposed approaches both in terms of reconstruction accuracy and computational costs.

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