4.5.19. STRUCTURE-ORIENTED ALGORITHMS OF VISUALIZATION OF ZONES OF CRACK FORMATION IN WELDING

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Structure-oriented (or group-theoretical statistical) approach was successfully applied to reconstruction of many test-objects in different areas of NDT, in particular, in civil engineering. [1]. As to computerized diagnostics of crack at the stage of formation, it remains to be a difficult problem. even with the use of this approach. A real crack in welding represents a complex "non-classical" object, extremely inconvenient for visualisation by tomographical methods. Even more, a reconstruction of crack can to serve as pattern of ill-posed problem, in which the "ill-posedness" appears in its utmost and grotesque form.

Generally speaking, image of "crack" which is registered on X-Ray projection is formed by set of microimages from numerous microcracks. The matter is each beam-sum with index k ($k = 1, ..., K$) in the each point of zone, where K different beams are intersected, contains projectional conntributions from microcracks with different orientation of angles α_k (i.e. the object under reconstruction is 4-dimensional and only with one representative beam-sum for the point (α, x, y, z)). Needless to say, that in these conditions the "individualized" tomographical visualization of microcrack as well as definition of its exact position are impossible. Nevertheless, a statistical "quasi-tomographical" approach become feasible with assumption of closeness of angular distribution of microcracks $w(\alpha)$ in a big enough "elementary volume" to the general distribution $W(\alpha)$ in zone, in other words assumption of spatial homogeneity of $w(\alpha)$, its invariantness with respect to arbitrary shifts in zone [3]. It is allowable if in the zone there is any preferable direction i.e. the symmetry (isotropy) of angular distribution $W(\alpha)$ is broken.

In the framework of this approach algorithms of structure-oriented filtering for projections of welding were elaborated [2, 3]. In essence, they are based on evaluation of degree of local anisotropy in the experimental distribution $w(\alpha, x, y, z)$, that in turn enables to reduce the problem to reconstruction of the "effective" scalar field $\mu_{ef} = \mu_{ef}(x, y, z)$. The further tomographical visualization was performed with the use of methods of non-linear tomosynthesis. The results (incl. testing of welding in components of nuclear power stations [2, 3]) are successful and they are supposed to be discussed in the lecture.

References:

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