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BOUNDARY INTEGRAL EQUATIONS IN CONTACT PROBLEMS FOR CRACKED MATERIALS UNDER IMPACT LOADING

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The present study is devoted to application of boundary integral equations to 2D and 3D problems for cracked materials under impact loading. The system of integral equations is derived from the dynamic Somigliana identity [1, 2] and the problem is solved numerically by the boundary elements method. One of the main difficulties of the boundary integrals' approach is the evaluation of divergent integrals with different types of singularity, which sometime should be treated in the sense of the Hadamard finite part.

Furthermore, in order to take the crack closure into account the Signorini constraints and the Coulomb friction law are imposed. Under deformation of the material the initial contact region changes in time; its shape is unknown beforehand and must be determined as a part of the solution. The complexity of the problem is further compounded by the fact that the contact behaviour is very sensitive to the material properties of the two contacting surfaces and parameters of the external loading. Such dependences make the contact crack problem highly non-linear. The considered problem requires an iterative solution procedure [2, 3], which solves linear the Neumann and Dirichlet problems with projections onto subsets of admissible displacements and contact forces. During the iterative process, the solution changes until the distribution of physical values satisfying the contact constraints is found.

The problem for a linear crack under oblique impact loading is solved for the first time taking the normal contact and friction of the crack faces into account. The distributions of the displacements and tractions are obtained and analysed. The dynamic stress intensity factors are computed as functions of the parameters of the incident loading and properties of the material. The results are compared with those obtained neglecting the crack closure, and the qualitative difference is discussed.

REFERENCES

[1] M.V. Menshykova, O.V. Menshykov, I.A. Guz, M. Wuensche, Ch. Zhang, A boundary integral equation method in the frequency domain for cracks under transient loading, *Acta Mech.*, Vol. **227**, pp. 3305–3314, 2016.

[2] A.N. Guz and V.V. Zozulya, Elastodynamic unilateral contact problems with friction for bodies with cracks, *Int. Appl. Mech.*, Vol. **38(8)**, pp. 895–932, 2002.

[3] M.V. Menshykova, O.V. Menshykov and I.A. Guz, An iterative BEM for the dynamic analysis of interface crack contact problems, *Eng. Anal. Bound. Elem.*, Vol. **35**, pp. 735–749, 2011.