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Anti-plane analysis of an infinite plane with multiple cracks based on strain gradient theory. (English) Zbl 1369.74007

Summary: The anti-plane stress analysis in an infinite elastic isotropic plane is carried out by using the distributed dislocation techniques in the framework of strain gradient theory. The technique involves the solution of a screw Volterra dislocation in the region. Employing a distributed dislocation solution indicated that the stress components reveal the familiar hypersingularity at the site of the dislocation. The solution for stress fields in integral form is obtained for a plane containing a Volterra-type screw dislocation via Fourier transform of the biharmonic equation. This method is extended to allow the solution of integral equations in the regions weakened by multiple smoothed curved cracks under anti-plane deformation. The integral equations are solved numerically for the density of dislocation on the crack surfaces. The numerical method in Chebyshev series forms is used to solve the hypersingular integral equations. The effects of interaction among cracks with different arrangements and those of the size effect on the stress intensity factors are discussed. To confirm the validity of the formulations, numerical values of the results are compared. The predicted results via the aforementioned approach are in excellent agreement with those in the literature. Some new examples are solved to demonstrate the applicability of the procedure.

MSC:
74A45 Theories of fracture and damage
74A10 Stress

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References:


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