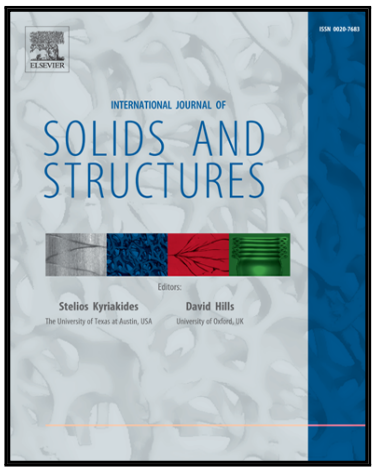

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Effect of a partial contact between the crack faces on its contribution to overall material compliance and resistivity.

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Abstract

Compliance and resistivity contribution tensors of a penny-shaped crack having a partial contact of arbitrary location along crack faces are found, in terms of contact size and its distance from the center. This result is a first step towards modeling of "rough" cracks having contacts between crack faces. Being applied to multiple cracks, our results yield the "adjusted", for the presence of contacts, value of crack density in terms of contact parameters. Similar results are obtained in the context of conductivity.

Keywords

Annular crack, contact, crack density, compliance, resistivity.

1. Introduction.

Cracks having partial contacts between crack faces are common in various materials. Clarke (1921) observed cracks of annular geometries in metal castings. Cai et al (2011) reported formation of annular cracks in human femur cortical bone during radial fretting. Kudinov (1977) reported formation of the flat annular pores in plasma-spraying process and evaluated relative size of the island of contact. Bhowmick et al (2007) observed cracks of similar geometry occurring in silicon subjected to fatigue contact loading. Figure 1 provides illustrations.

A partial contact between crack faces significantly "stiffens" the crack, even if the contact is small. This was discussed by Todoropki et al (1989) in the context of fatigue cracks who noted that ignoring the contacts produces incorrect estimates of the fatigue life. Yet another aspect of