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LETTERS IN FRACTURE AND MICROMECHANICS

COMMENT ON "COMPARISON OF THE NON-INTERACTION AND DIFFERENTIAL SCHEMES IN PREDICTING THE EFFECTIVE ELASTIC PROPERTIES OF FRACTURED MEDIA" BY V. GRECHKA

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Grechka (2007) considers in his paper with a static finite-element method the effective elastic properties for arrays of randomly located, isolated, parallel cracks with a crack density of $e = 0.15$. In the conclusions he stated the superiority of the non-interacting approximation (NIA) over the differential effective media (DEM) scheme for all stiffness coefficients influenced by the fractures. I have the following comments:

1) The crack distribution within one representative volume element (RVE) used by Grechka (2007) is different compared to the crack distribution used by Saenger et al. (2004). Grechka (2007) placed all cracks within the RVE and will not allow intersection with the boundaries of the RVE [see Figure 2 of Grechka (2007)]. By using a scaling factor δ=4.37 (RVE edge length/crack diameter) Grechka (2007) will place the midpoints of the cracks only in 60 % of the total volume of the RVE. This can not be treated as a random distribution of cracks. In contrast to this Saenger and Shapiro (2002) and Saenger et al. (2004,2006) always use periodic boundary conditions for the crack distribution (i.e. a crack can intersect the boundary of the RVE). The qualitative consequence is clear: Grechka (2007) considers in his paper one big crack cluster within the RVE. He always have a relative stiff frame around the cracks in his numerical considerations. Therefore it is clear that his results tend to the stiffer predictions of the NIA.
2) In the discussion section of Grechka (2007) some hyphotheses are given which should explain the reason why the dynamic finite-difference (FD) simulations of Saenger et al (2004) support the DEM while the static computations of Grechka (2007) support the NIA. In this context two points are important: First, the accuracy of the used FD approach for inclined cracks was studied by Krüger et al. (2005). Secondly, with the 2D static considerations of Saenger et al. (2006) we have shown that dynamic transmission experiments in the long-wavelength limit predict the same effective elastic properties as static experiments (with an appropriate scaling factor δ). These experiments as well as the numerical determination of reflection coefficients by Krüger et al. (2007) support in every case (2D, 3D, different crack distributions and densities) the superiority of the DEM.

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