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## Early cracking orientation under high stress gradients: The fretting case

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### ABSTRACT

Many fretting contacts experience a rapid variation of the magnitude and relative contribution of the stress components away from the surface. This feature of the fretting problem poses an additional difficulty for the modeling of the early cracking orientation. In this work, critical plane approaches associated with a process zone are evaluated by taking into account the fretting crack behavior observed in two different steels. The results show that the conventional approaches may provide inconsistent cracking directions. A new method for early cracking orientation prediction is developed by employing the average values of the normal and shear stresses along a critical direction. This method is simpler to implement and improves the estimates when compared to the other approaches.

*Keywords:* fretting; stress gradient; critical plane approach; cracking orientation

### Nomenclature

$a$	semi-width of the contact
$a_1(\varphi), a_2(\varphi)$	half-sides of a $\varphi$ -oriented rectangular hull
$E$	Young's modulus
$f$	coefficient of friction
$k$	material constant in the Fatemi–Socie parameter
$L$	material characteristic length
$P$	normal load (per unit length of contact)
$Q_a$	tangential load amplitude (per unit length of contact)
$R$	radius of cylindrical contact pad
$t$	time
$x$	ordinate parallel to contact surface
$y$	ordinate normal to contact surface
$\Delta K_{th}$	threshold stress intensity factor range
$\Delta\sigma_{-1}$	uniaxial fatigue limit range

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