Outline Instability of Sealed Crack Tip of Plate Boundary Rocks

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In many studies of the sealed cracks, the stress concentration at crack tip and its relaxation by plastic and subsidiary brittle deformation around the tip are discussed in the two dimensions, although there is almost always no investigation of the three-dimensional pattern of the crack tip line in the deep-seated rocks. This may be due to the reason that the crack edge line cannot be observed by the usual techniques in the rock mechanics.
There are many cross - section patterns of the sealed cracks having the various width of the single sealed cracks. These sealed cracks commonly display periodic variation of thickness of the sealed cracks that apparently exhibits the continuous one. Considering the monotonous change of thickness of the sealed open crack from the crack edge, it shows that the thickness variation of the single sealed crack is responsible for the variation of the distance from the crack edge. Therefore, it is possible that the outline of the sealed open crack is drawn by the variation of the thickness of the continuous single sealed open crack.
Then, the distance between the observed point and the edge (tip) of the sealed open crack can be estimated using the correlation between the average gray scale intensity of the pixels and the above distance.
The relationship for the correction coefficient of the distance from the edge from the square of the gray scale intensity of pixels is obtained from the simple monotonous sealed open crack by measurement of the width and pixel gray intensity along the whole crack length. Furthermore, the shortest distance from the crack can be estimated from the width of the sealed open crack using the geometry of the simple monotonous sealed crack.
Let us consider that the flat open crack edge outline appears in the initial condition, and after the enough short time, it changes to the wavy outline of the edge changes small perturbation with wavenumber k. The front velocity of the open crack tip per unit length of the tip outline should be controlled by the crack growth depending on the stress intensity factor (Wei, 2010). Then, we obtain the preferential wavelength of the perturbation of the crack tip outline by linear stability analysis as,
$w = 2\,h^{1/4}(g / a\,s)^{1/2}$
where, h is crack radius, g is line tension of crack tip and s is differential stress.
reference
Wei, RP., 2010, Fracture Mechanics: Integration of Mechanics, Materials Science, and Chemistry, Cambridge Univ. Press.

Keywords: crack tip outline instability , bowing out crack tip, Rayleigh - Taylor instability

