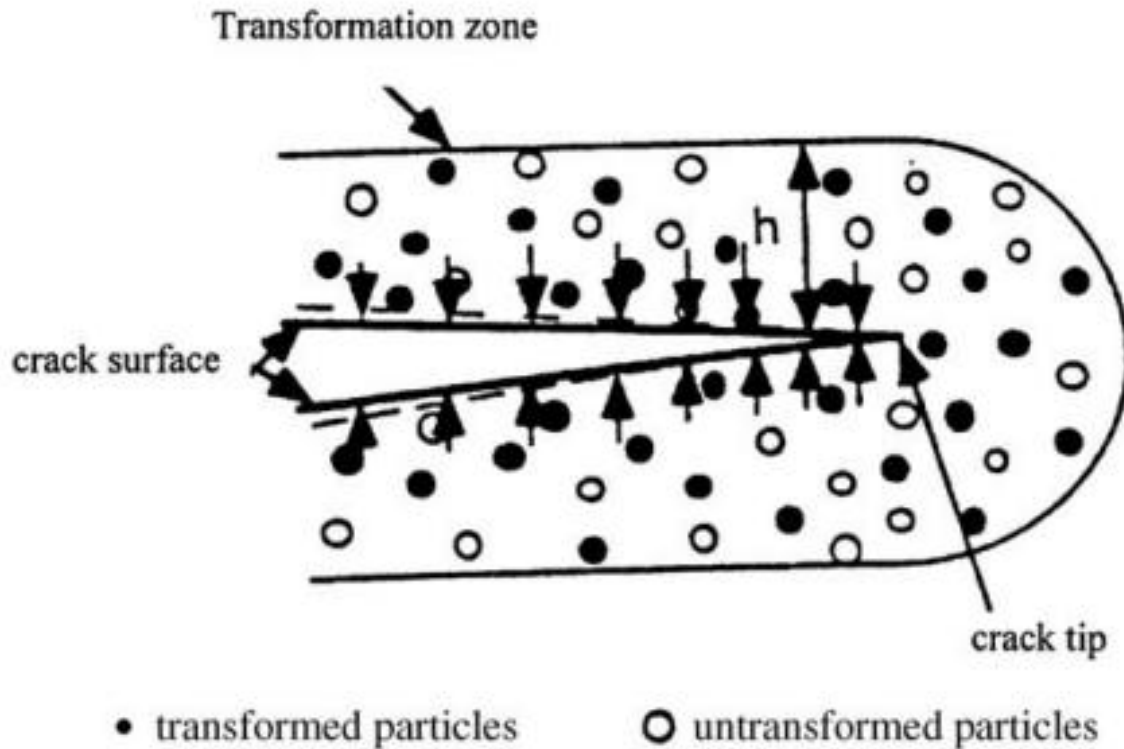# Discrete modeling of transformation toughening in heterogeneous materials

O. Kovalev (5 course, dep. of TM)

R. Filippov (Ph.D., IPME)
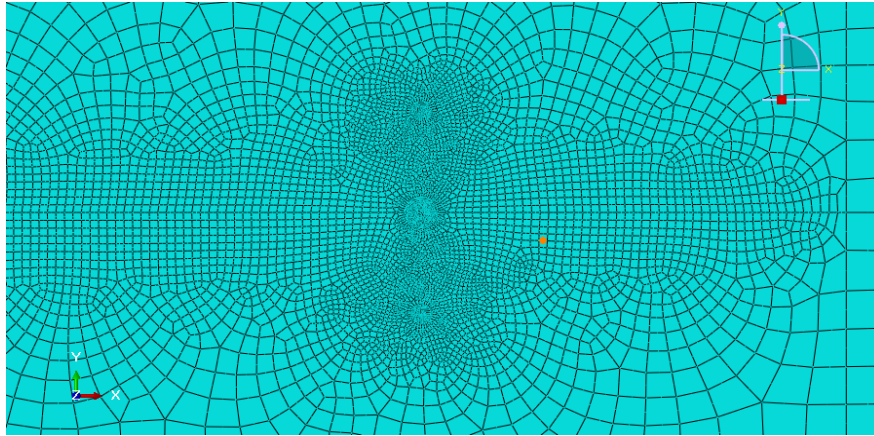
THE PROBLEM
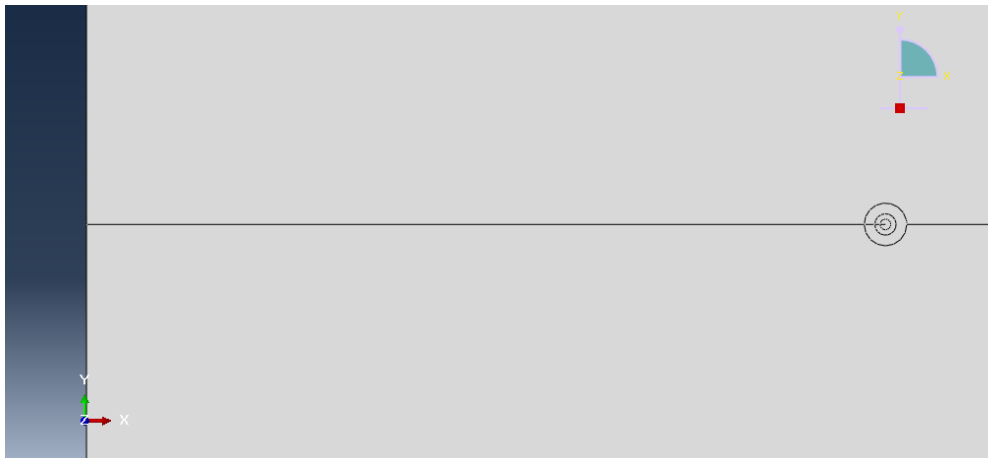
- Crack growth in ceramics with inclusions

Transformation zone

crack surface

h

crack tip

- transformed particles   O untransformed particles
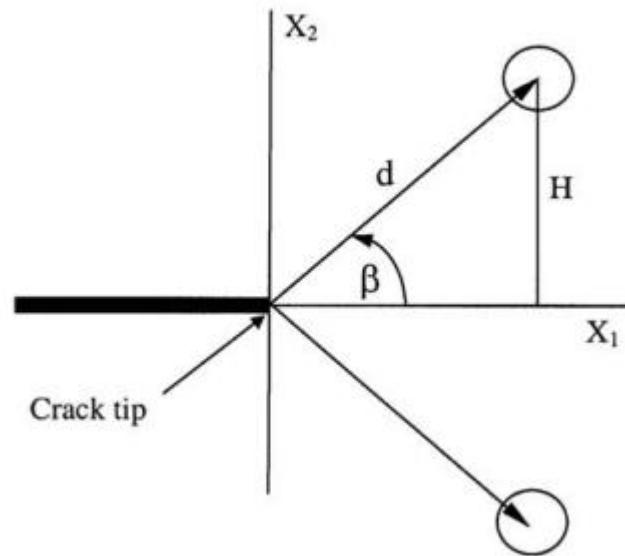
THE MODEL

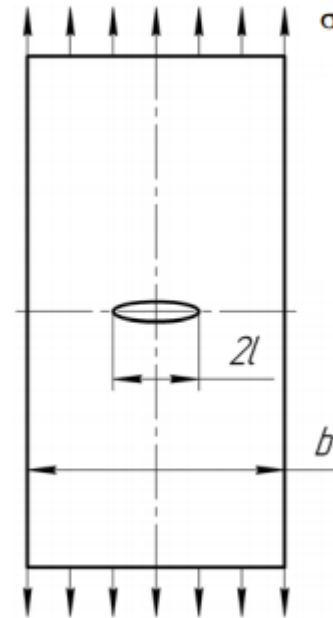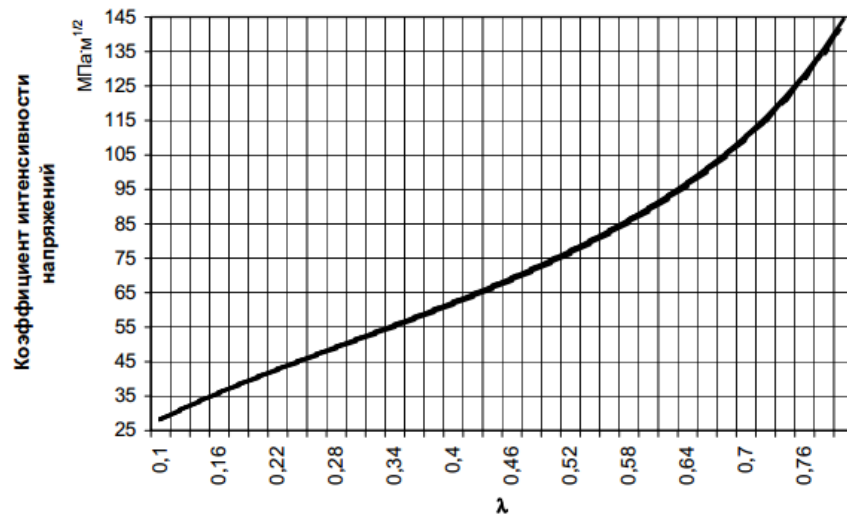- Final element model in Abaqus.

- The seam method used

TASKS

- Verification of fracture model
- The problem of two inclusions
- Selecting the size of the area

VERIFICATION

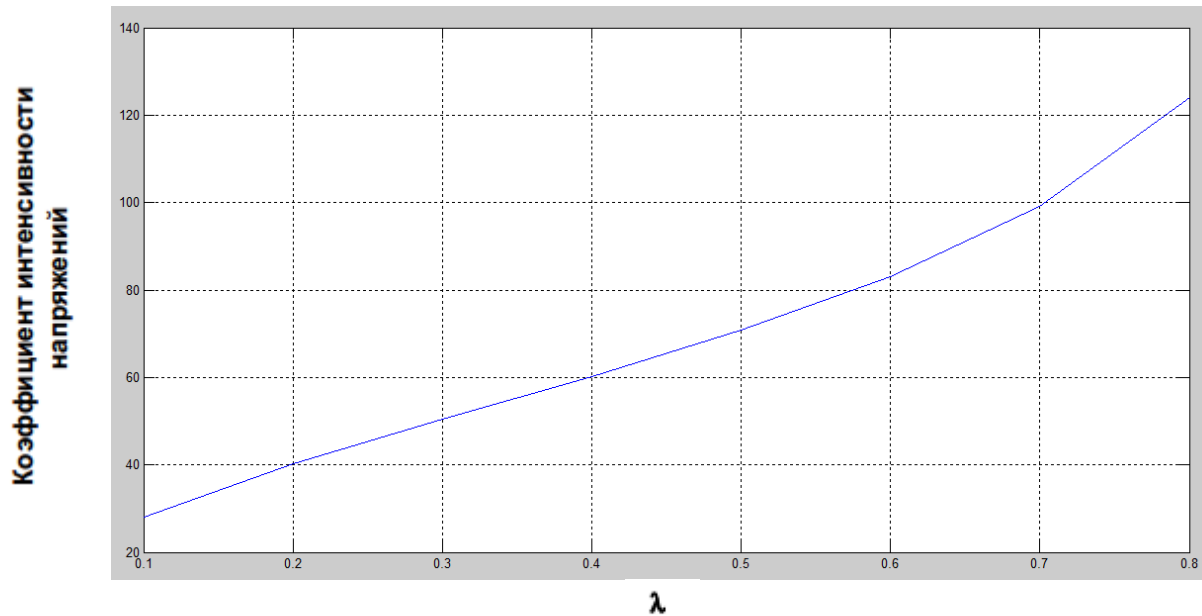Плоский образец с центральной трещиной

$$K_I = \sigma\sqrt{\pi l}\,\frac{1-\frac{\lambda}{2}+0{,}326\lambda^2}{\sqrt{1-\lambda}}$$
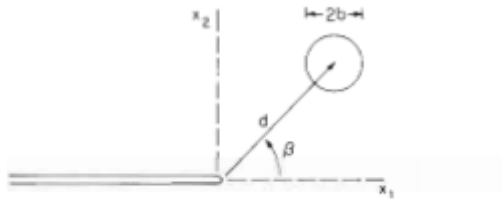
$$\lambda = \frac{2l}{b}$$

Рис. 3

Result:

THE PROBLEM OF TWO INCLUSIONS

- Budiansky's solution

$$\Delta K_{tip} = \sqrt{\left(\frac{\pi}{8}\right)} \frac{Eb^2\Omega}{(1-v^2)d^{3/2}} \cos\frac{3}{2}\beta.$$

$$\Omega = \frac{2}{3}(1+v)\theta.$$

Symmetrically placed dilatant circular spots at a crack tip.

- Result to compare

Fig. 6. Comparison of the ΔK with Budiansky's solution.

THE MODEL

- Model of particles

$$\sigma_{ij} = \lambda_{\mathrm{p}}\varepsilon_{kk}\delta_{ij} + 2G_{\mathrm{p}}\varepsilon_{ij} - B_{\mathrm{p}}\theta\delta_{ij}$$

SELECTING THE SIZE

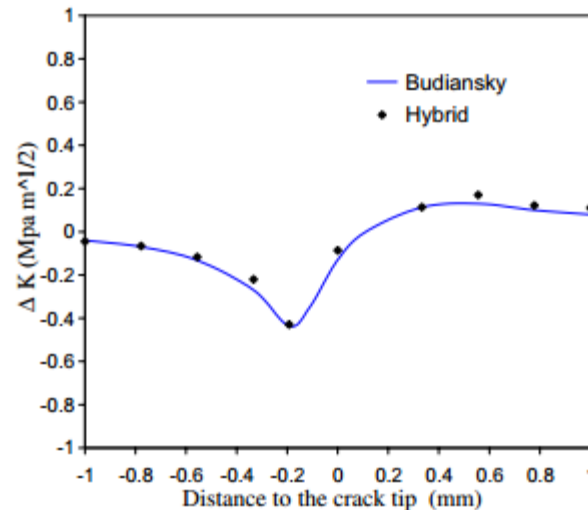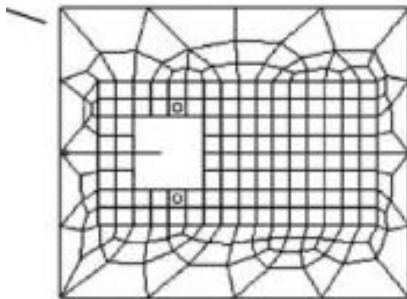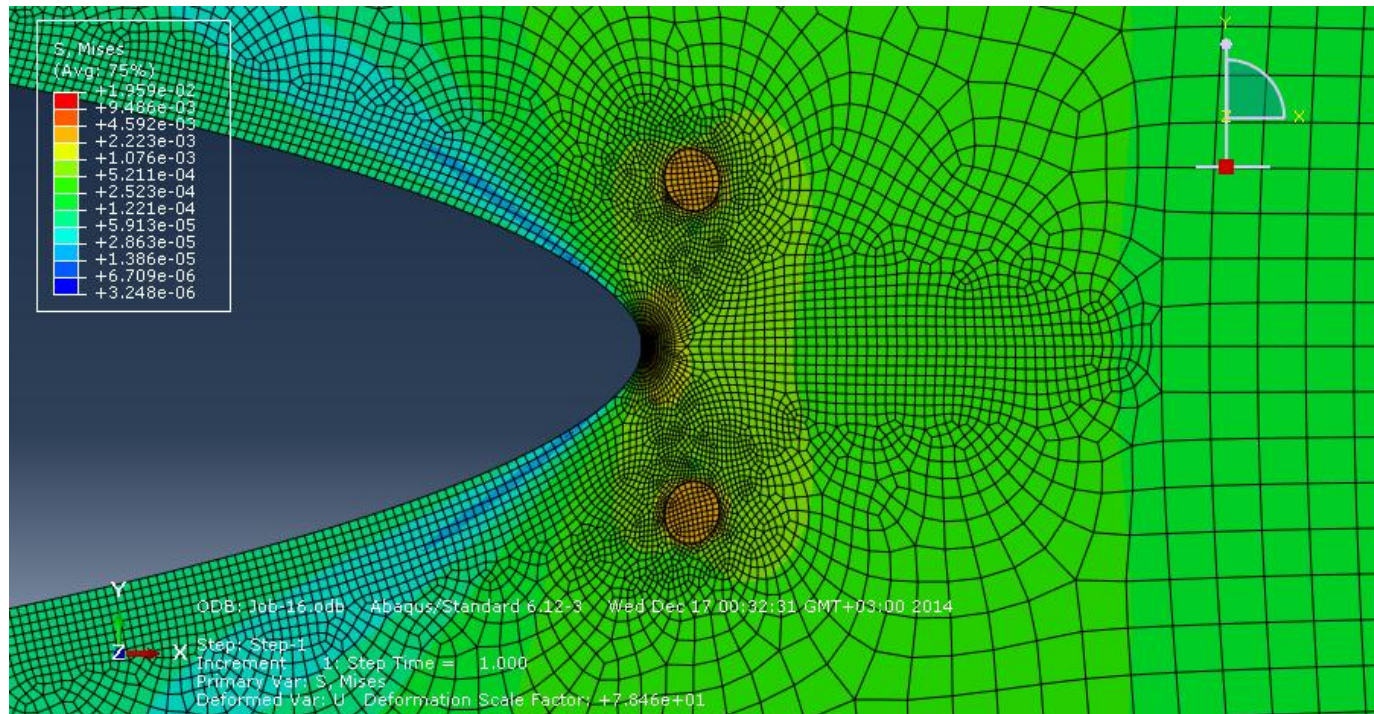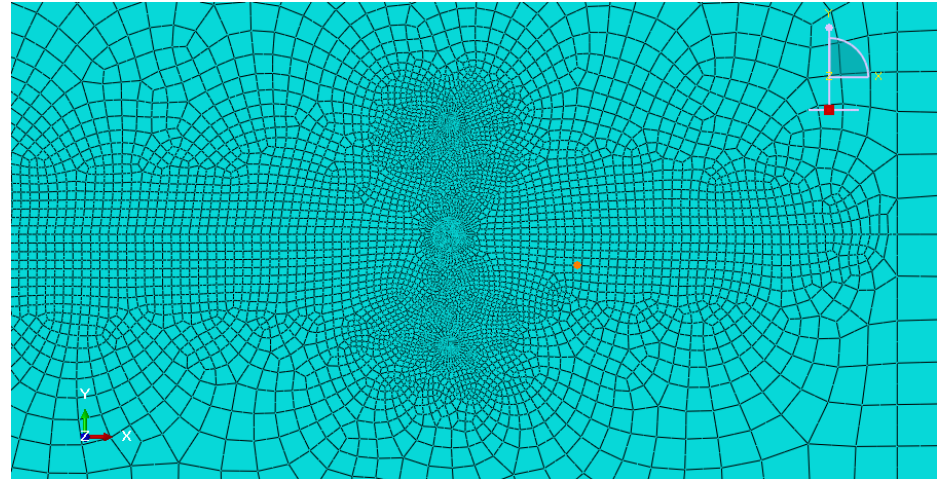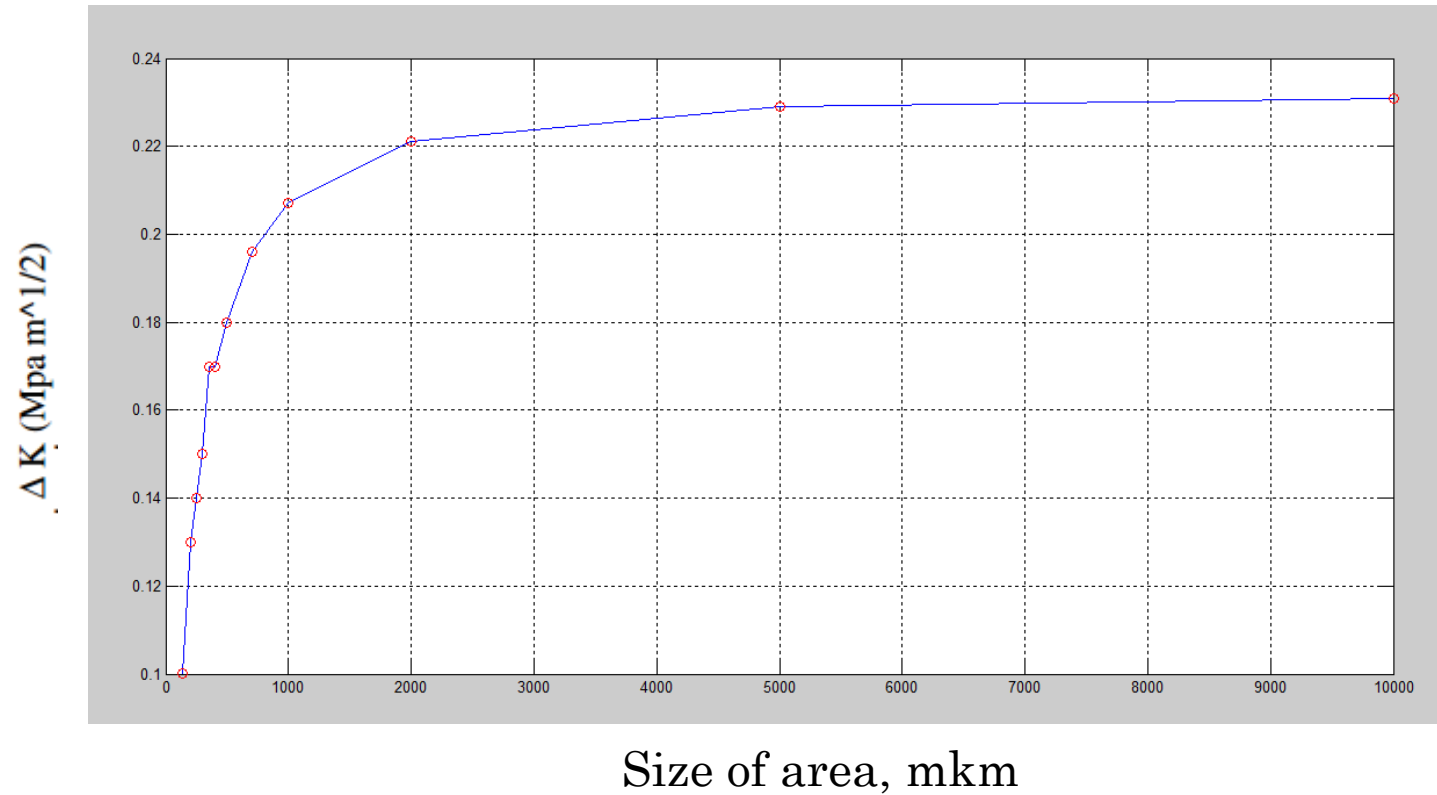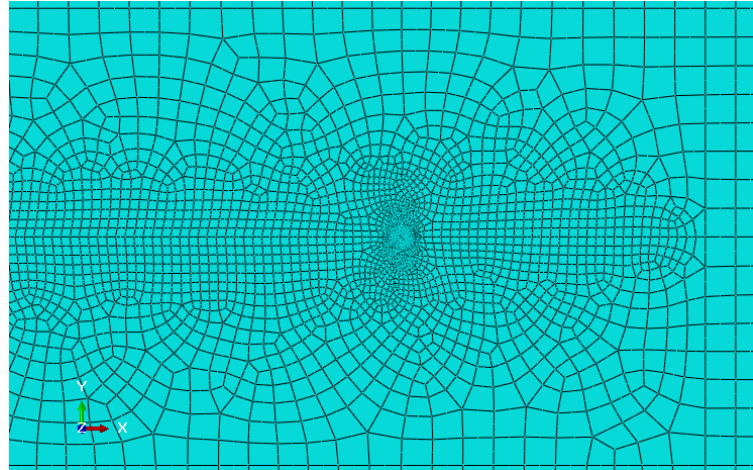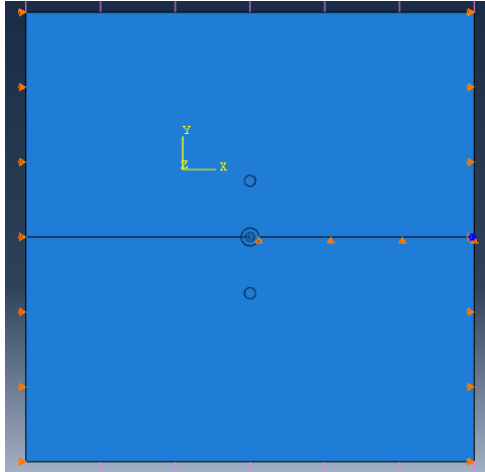Size of area, mkm

RESULT

Distance to the crack tip (mm)
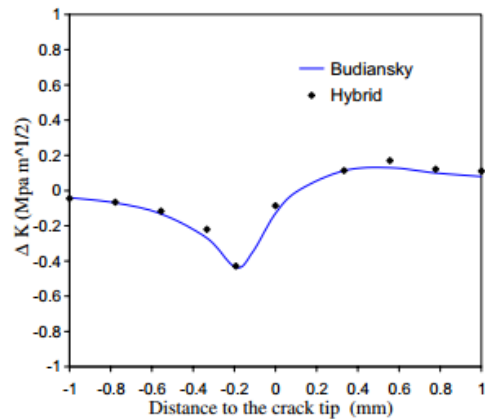

Fig. 6. Comparison of the ΔK with Budiansky's solution.

$$\Delta K_{tip} = \sqrt{\left(\frac{\pi}{8}\right)} \frac{Eb^2\Omega}{(1-v^2)d^{1/2}} \cos\frac{3}{2}\beta.$$

$$\Omega = \frac{2}{3}(1+v)\theta.$$
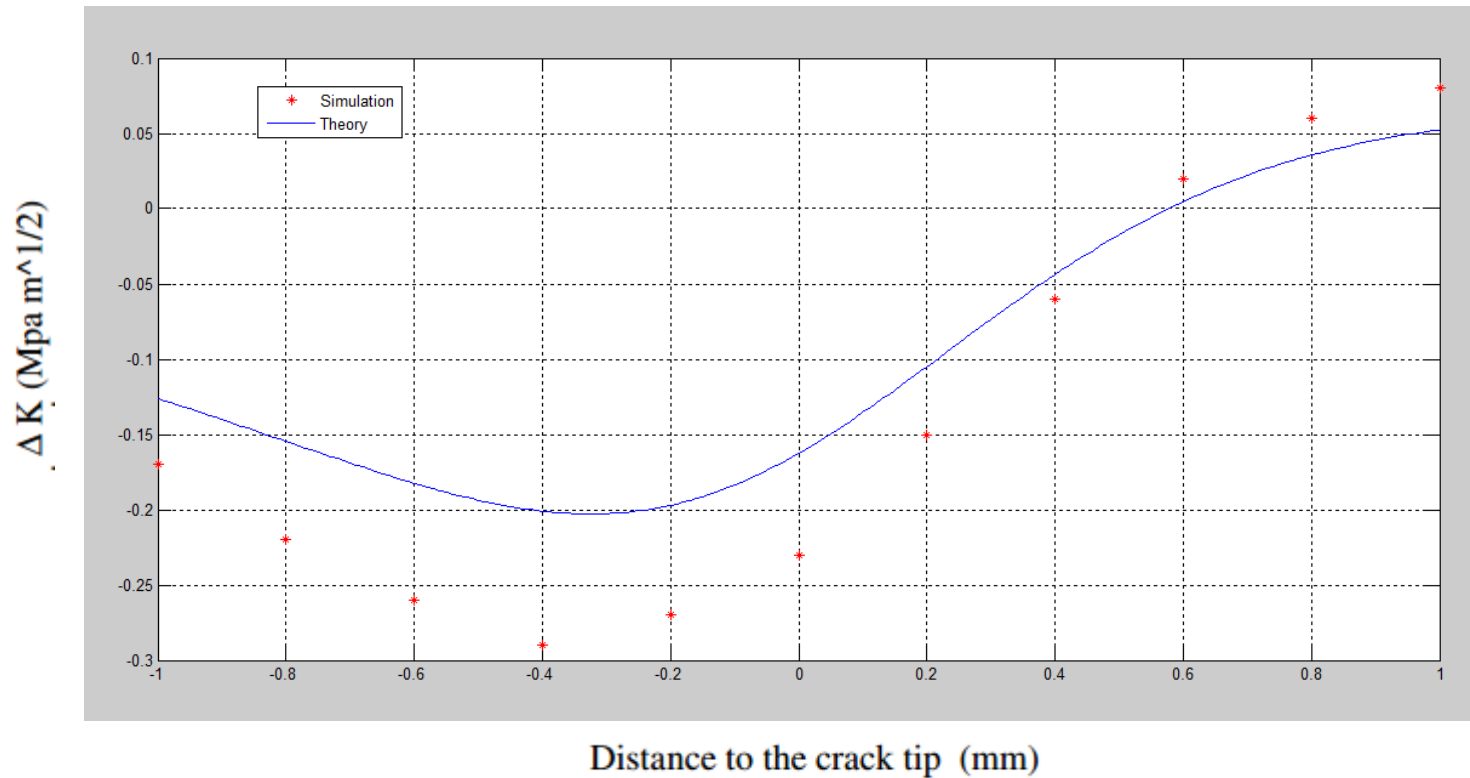
Thank you for your attention!