XFEM Project
XFEM et Méthodes particulaires
Master MS2SC 2022-2023

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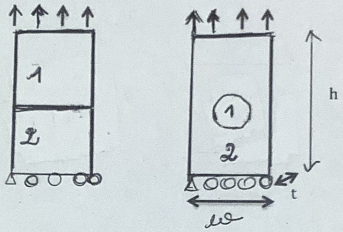
Consider a plate composed of two elastic materials of Young's moduli E_1 and E_2 respectively and of Poisson ratios v_1 and v_2 respectively. We consider that material 1 is twice stiffer than material 2. The plate is of width w, height h, and thickness t with w=h/2. The plate is fixed at the bottom left corner and cannot move in the y direction along the bottom edge. The top surface is subjected to a vertical traction force **t**.



CASE 1 CASE 2

1- Model the plate CASE 1 using standard Finite Element Method. Resolve the displacement field. Plot the stress and strain fields inside the plate.

2- Model the plate CASE 1 using the XFEM method with the classical weak discontinuity enrichment (non-shifted):

$$u^h(x) = \sum_{I \in \mathcal{J}} N_I(x) u_I + \sum_{I \in \mathcal{J}^*} N_I(x) \, |\phi(x)| a_I$$

You can either calculate $\phi(x)$ as an explicit level set function at the Gauss points or use an implicit discretized formulation inside an element, e, as follows: $\phi(x) = \sum_{I \in \mathcal{J}_e} N_I(x) \phi_I$
If you choose either method, please explain. Resolve the displacement field in the plate. Plot the stress and strain fields inside the plate. Compare to the fields calculated using standard FEM.

3- Model the plate CASE 1 using the XFEM method with the alternative formulation for weak discontinuity enrichment:

$$u^h(x) = \sum_{I \in \mathcal{J}} N_I(x) u_I + \sum_{I \in \mathcal{J}^*} N_I(x) \left(\sum_{I \in \mathcal{J}^*} N_I(x) |\phi_I| - \left| \sum_{I \in \mathcal{J}^*} N_I(x) \phi_I \right| \right) a_I$$

Resolve the displacement field. Plot the stress and strain fields inside the plate. Compare to the fields calculated with the non-shifted XFEM formulation obtained in question 2.

4- Consider now a plate CASE 2 with a circular inclusion of radius, r=w/4, in its center made of material 1 inside a matrix made of material 2. Model the plate with the circular inclusion using the XFEM method with the alternative formulation for weak discontinuity enrichment. Resolve the displacement field. Plot the stress and strain fields inside the plate.

Instructions:

- For you program, use Matlab.
- Please write a small report explaining what you developed for each question and your results.
- Attach the Matlab program to your report.
- Submit your project by email to ebudyn@ens-paris-saclay.fr