An enriched cohesive zone model for delamination in brittle interfaces

Citation for published version (APA):

Samimi, M., Dommelen, van, J. A. W., & Geers, M. G. D. (2009). *An enriched cohesive zone model for delamination in brittle interfaces*. Poster session presented at Mate Poster Award 2009 : 14th Annual Poster Contest.

Document status and date:

Published: 01/01/2009

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

An enriched cohesive zone model for delamination in brittle interfaces

M. Samimi,
J. A. W. van Dommelen,
M. G. D. Geers

Introduction

Application of conventional cohesive zone models (CZM) to simulate delamination in brittle interfaces may trigger non-smooth load displacement responses that lead to failure of iterative solution procedures. This non-smoothness is an artifact of the discretization and can be avoided by sufficiently refining the mesh.

Enriched cohesive zone model

Alternatively, an adaptive hierarchical extension is proposed to enrich the separation approximation in the process zone (see figures 1 and 2).

Fig. 1 Enrichment of interpolation functions.

Fig. 2 Deformation of an enriched cohesive zone element.

Peel-off test

An elastic bulk material characterized by $C_{nn} = 45$ GPa and $C_{sn} = 0$ is pulled from a rigid substrate as shown in figure 3. Interfacial behavior is described by a bi-linear traction-separation law (see figure 4).

Fig. 3 Peel-off test.

Fig. 4 Traction-separation law and parameters.

Using one bulk/cohesive zone element, the optimum position of

a within the interface is obtained by minimization of the total work, as shown in figure 5.

Fig. 5 Enrichment peak position variation through the deformation process.

Results: Mode I delamination

Peel-off test shown in figure 3 with a relatively brittle interfacial behavior ($C_{nn} = 27$ GPa) is analyzed by using a coarse mesh of 10 bulk/cohesive zone elements.

Fig. 6 Force displacement diagram of peel-off test.

As depicted in figure 6, the new enrichment scheme improves the global load displacement response of the system discretized by a relatively coarse mesh without a need for further mesh refinement.

Conclusions and remarks

- Mobile piece-wise linear enrichment improves the efficiency and robustness of a CZM.
- Extension of the proposed enrichment scheme to mixed mode delamination is in progress.

References:

- [1] M. SAMIMI ET AL.,: *An enriched cohesive zone model for delamination in brittle interfaces* Int. J. Numer. Meth. Engng, 2009.