UNIVERSITY OF TRENTO - Italy

UNIVERSITÀ DEGLI STUDI DI BRESCIA

IUTAM 2012 Symposium

FRACTURE PHENOMENA IN NATURE AND TECHNOLOGY

July 1-5, 2012
Brescia, Faculty of Engineering

http://events.unitn.it/en/iutam2012

UNIVERSITA' DEGLI STUDI DI BRESCIA

UNIVERSITY OF TRENTO - Italy

BRESCIA
Faculty of Engineering
Via Branze, 43

July 1-5, 2012

Chairman: Prof. Davide Bigoni

SYMPOSIUM PROGRAMME
and
BOOK OF ABSTRACTS

OBJECTIVE

The objective of the Symposium is fracture research, interpreted broadly to include new engineering and structural mechanics treatments of damage development and crack growth, and also large-scale failure processes as exemplified by earthquake or landslide failures, ice shelf break-up, and hydraulic fracturing (natural, or for resource extraction or CO_2 sequestration), as well as small-scale rupture phenomena in materials physics including, e.g., inception of shear banding, void growth, adhesion and decohesion in contact and friction, crystal dislocation processes, and atomic/electronic scale treatment of brittle crack tips and fundamental cohesive properties.

Special emphasis will be given to multiscale fracture description and new scale-bridging formulations capable to substantiate recent experiments and tailored to become the basis for innovative computational algorithms.

GENERAL INFORMATION

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SOCIAL PROGRAMME

Welcome Reception at the City Hall

Monday July 2, 2012. *In the evening: Lord Mayor Reception at Brescia City Hall.*

Social Dinner

Tuesday July 3, 2012. *In the evening: visit to the Basilica Romana Minore in Verolanuova-Brescia. Social dinner at "Restaurant Villa Zaccaria" in Bordolano-Cremona.*

Accompanying Persons Tours

Monday July 2, 2012. *In the early afternoon – Guided tour at a winery in Franciacorta. Visit to the cellars and wine tasting at the end.*
Tuesday July 3, 2012. *In the morning – Guided tour at the historical city of Brescia, and at the Castle of Brescia with a mini train.*
Wednesday July 4, 2012. *In the afternoon - Guided tour at the wonderful "Isola del Garda" on the Garda lake and free visit at the historical city of Salò, over Garda lake.*

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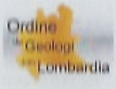

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Seminario Matematico Bresciano

Crack propagation within an inhomogeneous structured solid

M.J. Nieves[†], D.J. Colquitt[*], N.V. Movchan[*],
I.S. Jones[†] and A.B. Movchan[*]

Models for cracks propagating in uniform lattices have been extensively studied in [1]. They can be used to determine regions of crack speeds for which we have steady state crack motion. More recently, the model describing a structured interface along a crack with a harmonic feeding wave localised at the crack, was used to predict the position of the crack front. Numerical simulations were presented in [2, 3] showing that, for a given range of frequencies of the feeding wave, it was possible to have uniform crack growth or, in the non-linear regime of non-steady propagation, to identify an average crack speed, which is consistent with the prediction of the linear model linked to the crack propagating steadily.

It is possible to consider types of non-uniformity within a lattice, which can bring new effects in the wave dispersion and filtering properties of the structure. Propagation of a Mode I semi-infinite crack through an infinite discrete elastic triangular lattice, with bonds having a contrast in stiffness in the principal lattice directions, has been studied in [4]. This stiffness contrast in the bonds within the lattice can be interpreted, for example, as the effect of thermal pre-stress of a constrained lattice whose ligaments have different coefficients of thermal expansion. The problem was solved using the approach of Slepyan in [5]. The method leads to an equation of the Wiener-Hopf type along the crack face, where the kernel function of this equation is linked to the corresponding Green's kernel for the problem. Analysis of this kernel leads to explicit wave dispersion relations for the crack within the lattice. We present a summary of the results in [4], and using these dispersion relations, we show that the average crack speed for a Mode I crack within a thin strip can be predicted for particular frequencies of the feeding wave.

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References

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Effect of a micro-structure on the thermal striping damage of an edge-cracked slab

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Abstract

Thermal striping is the phenomenon of temperature fluctuation caused by the incomplete mixing of a fluid at different temperatures. A structure exposed to this temperature variation can suffer thermal fatigue damage. Such situations occur in pressurised water reactors and the above-core region of fast reactors. The model of thermal striping damage of components containing edge cracks in a continuum has been studied in [1], [2]. For the case of an edge-cracked slab under sinusoidal striping [3], an analytical representation for the stress intensity factor of the edge crack was derived. The amplitude of the stress intensity factor was investigated as a function of the crack depth and was shown to also depend on the frequency of the sinusoidal striping and the aspect ratio of the slab. Can damage be reduced by developing materials with micro-structure?

In this talk, we consider a micro-structured elastic slab containing an edge crack, subjected to sinusoidal thermal striping. In this case, the micro-structure is fully discrete and takes the form of a genuine triangular lattice in the vector setting of planar elasticity. It is well known that, in the continuum, the stress field is singular at the crack tip, whereas for a crack in a lattice, there is merely a stress concentration at the crack front bond. Here, we analyse the local properties of the crack in the lattice and compare these with those of a corresponding homogenised medium. In particular, we introduce the notion of an "*effective stress intensity factor*" for the edge crack in the lattice, obtained from the crack tip displacements. The effect of varying the number of lattice cells per unit area on this "*effective' stress intensity factor*" is examined and compared with the continuum limit.

Acknowledgements

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