Caractérisation du comportement en fissuration des milieux orthotropes par couplage méthodes optiques – éléments finis

Octavian POP

50 ANS Université de Limoges

GC2D

Laboratoire de Génie Civil, Diagnostic et Durabilité

Bois ï Construction et Durabilité

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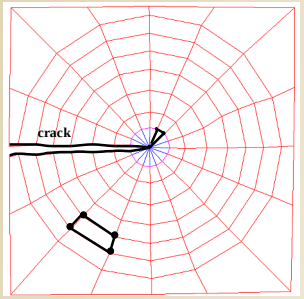
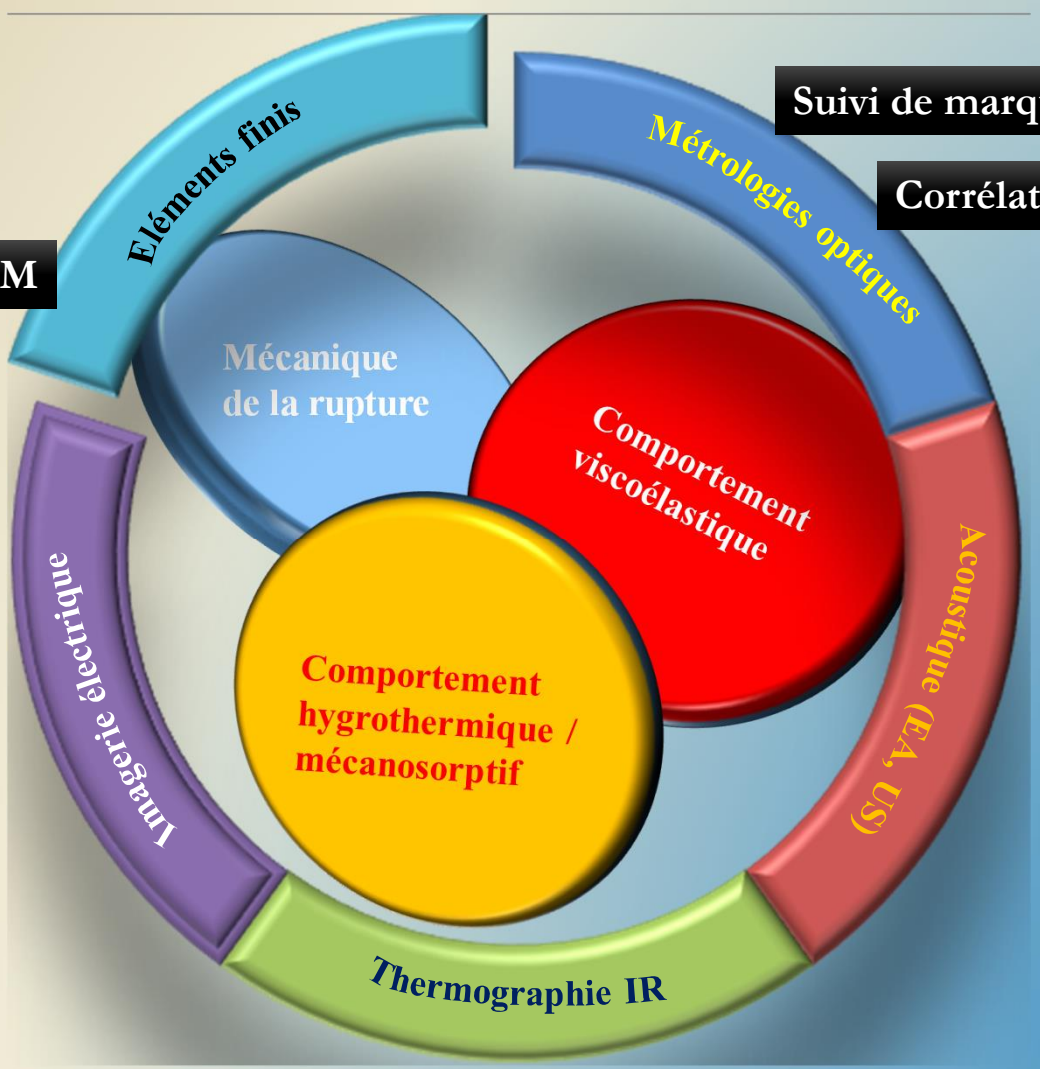
Laboratoire de Génie Civil, Diagnostic et Durabilité

Thématiques de recherche

CAST3M





Suivi de marqueurs

Corrélation d'images numériques

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Département 3
Axe PEM

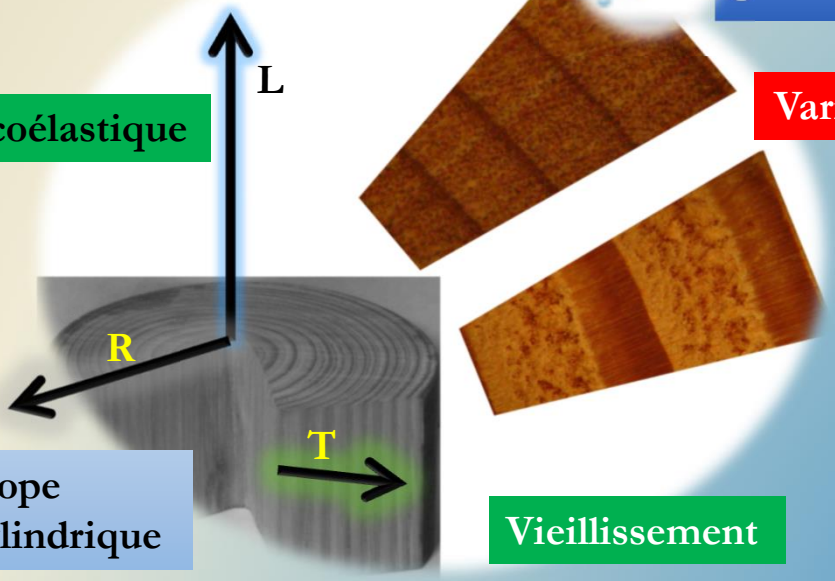
Le matériau bois

Complexe et Hétérogène

Sensibilité hygrothermique

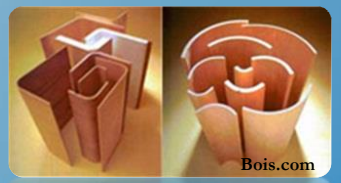
Variabilité selon l'essence

Comportement viscoélastique



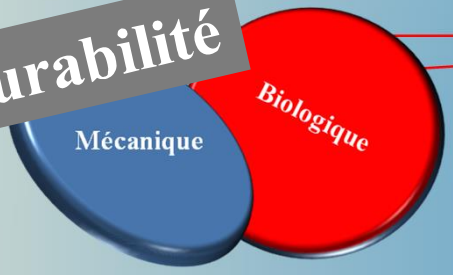
Orthotrope
orthotropie cylindrique

« Effet mémoire »



Vieillissement

La durabilité



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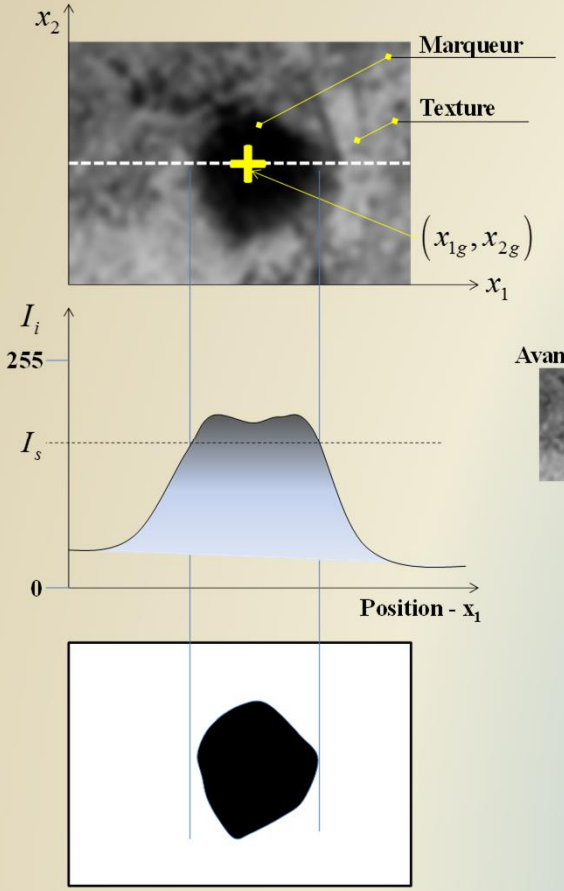
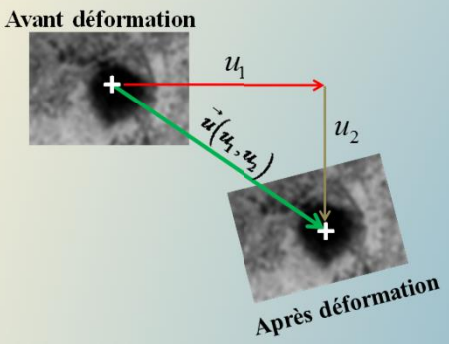
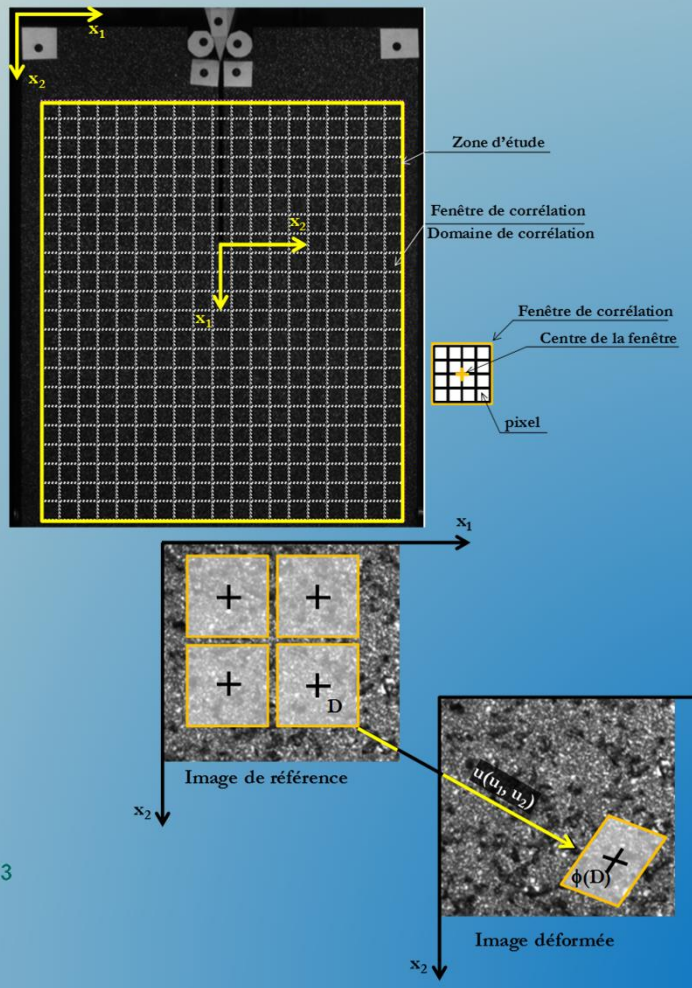
Les méthodes optique

Suivi de marqueurs — Deftac





Corrélation d'images numériques — Corréla



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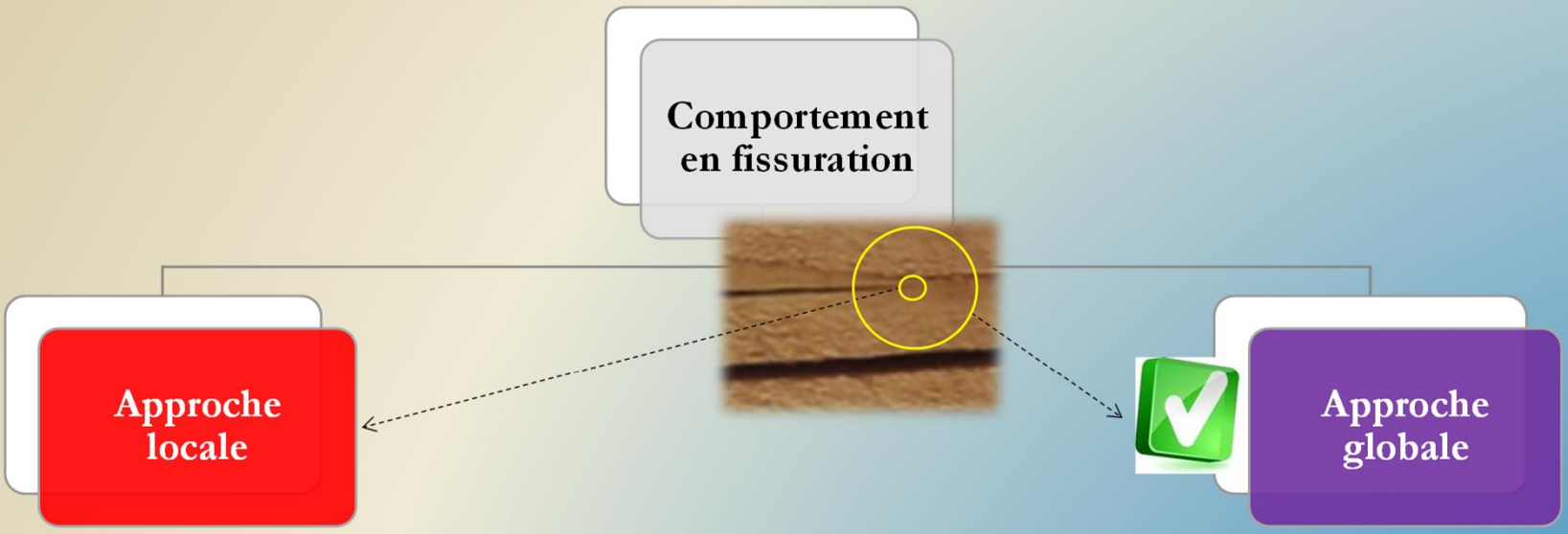
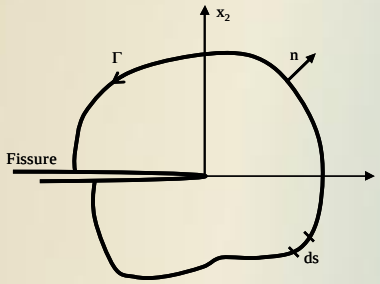
Département 3
Axe PEM

Les approches



- Modélisation locale de l'endommagement.
- Champs locaux.

- Approche énergétique.
- Intégrales invariantes J, G et M.
- Champs mécaniques semi-lointains ou lointains.



$$J = \int_{\Gamma} \left(W \cdot n_1 - T_i \cdot \frac{\partial u_i}{\partial x_1} \right) \cdot ds$$

Les approches

Couplage expérimental – numérique

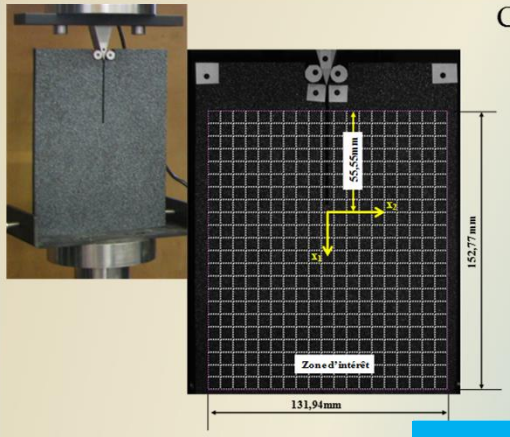
$$G\theta = \int_S \left(u_{i,k} \cdot \sigma_{ij} \cdot \theta_{k,j} - W \cdot \theta_{k,k} \right) \cdot dS$$

Approche Expérimentale

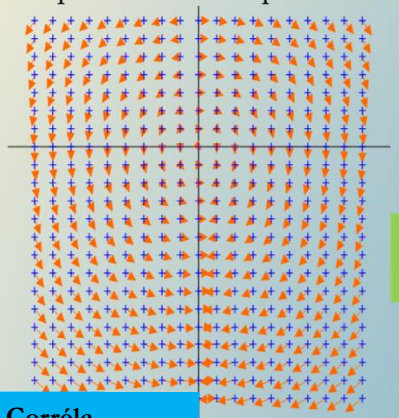
Approche Numérique

Mesure expérimentale du champ de déplacements par Corrélation d'Images Numériques

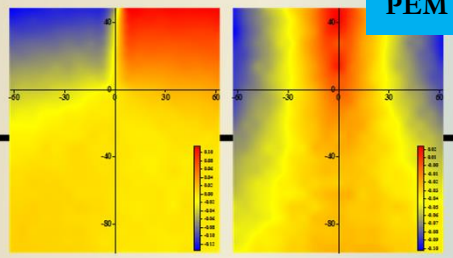
Modélisation numérique



Champ vectoriel des déplacements

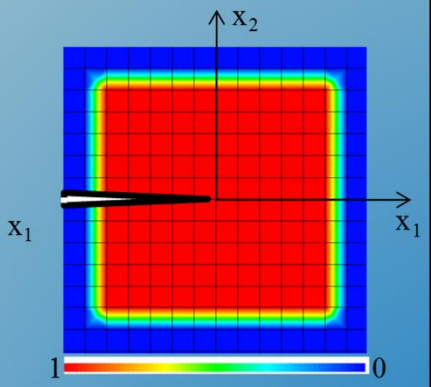


Corréla
PEM – Pprim Poitiers



+ les paramètres de la Loi constitutive

W σ_{ij}

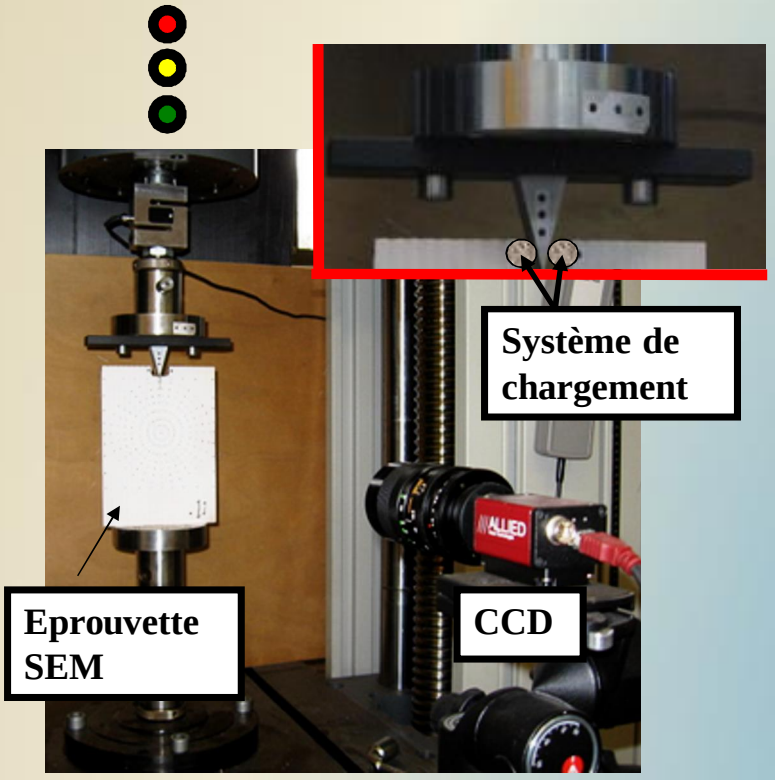


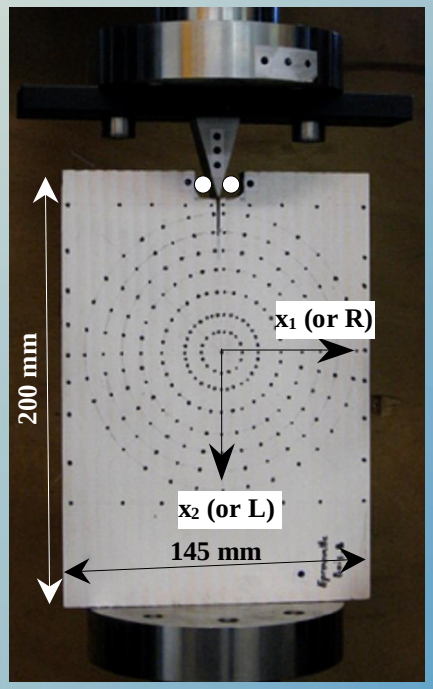
Champ vectoriel θ

$G\theta$ Taux de restitution d'énergie

Les exemples

Fissuration





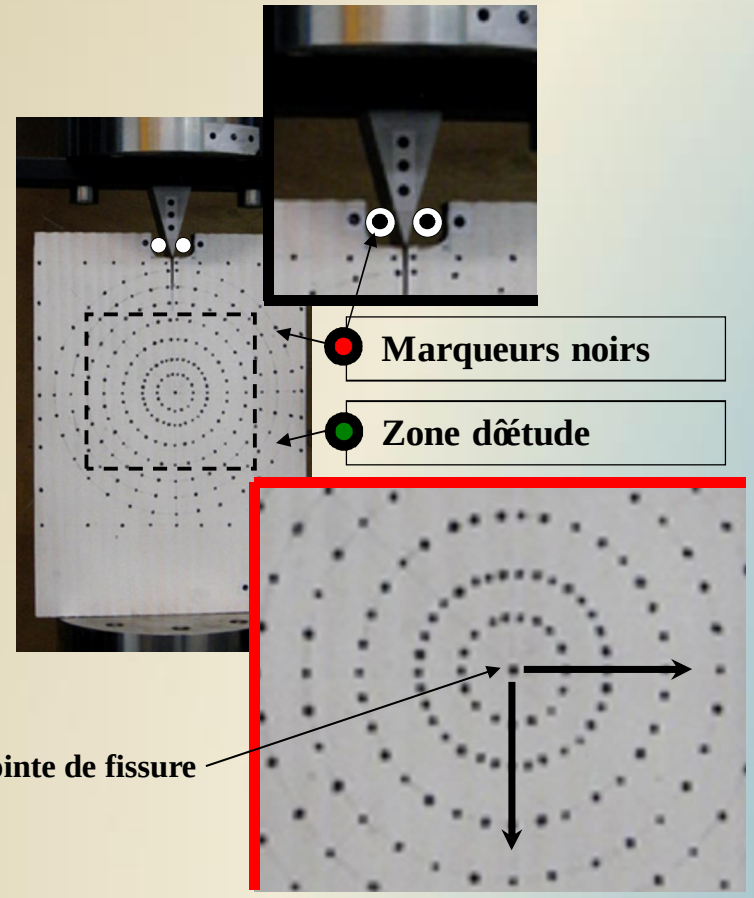
- Eprouvette SEN
- Matériau: Douglas
- Orientation RL
- Fissure: 80 mm

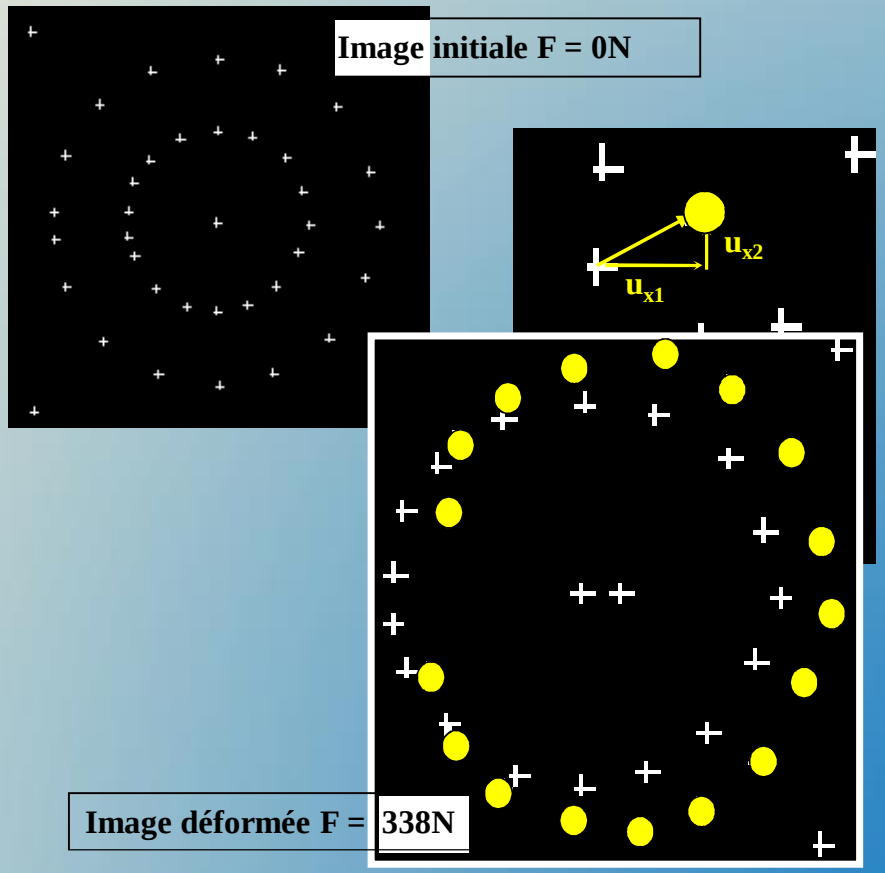
Orientation des cernes

Les approches

Fissuration

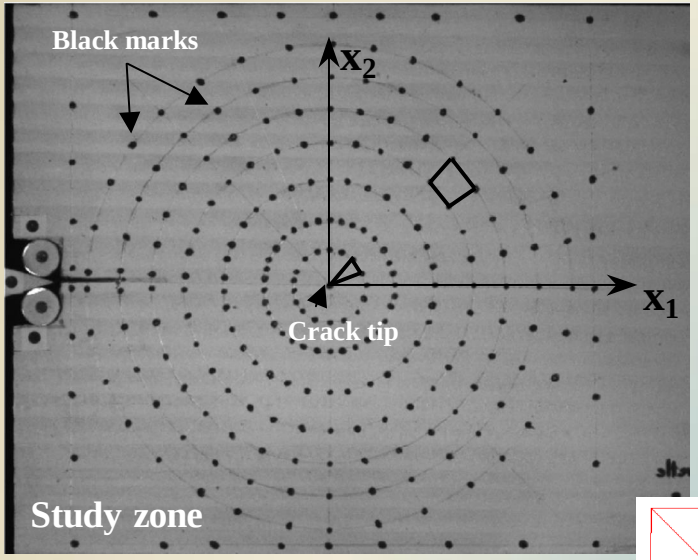
Suivi de marqueurs





Les approches

Fissuration



Barycentre of the marks

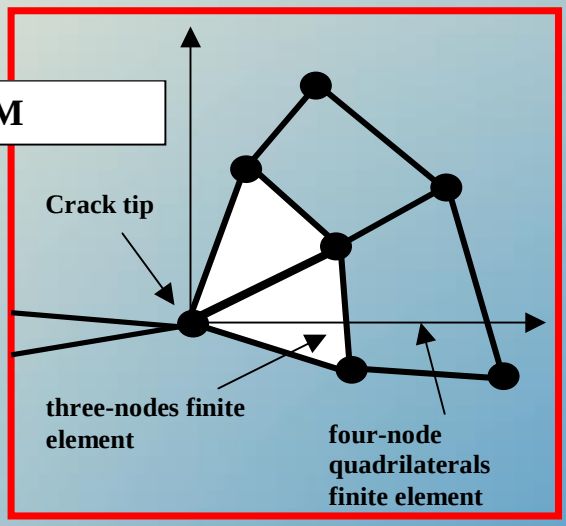
↓

FE mesh

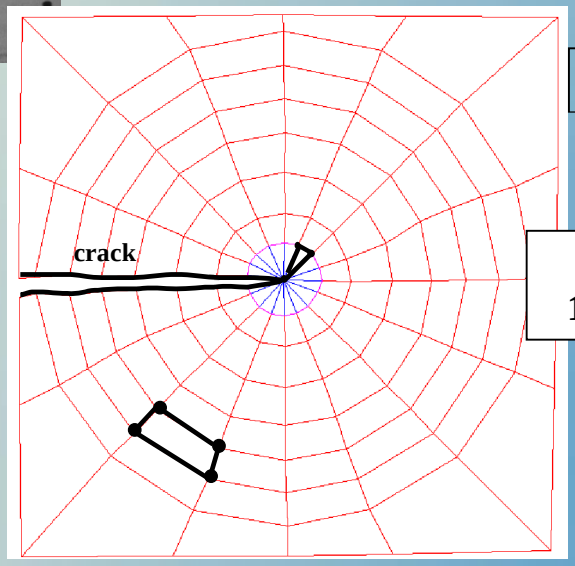
↓

Projection of the displacement fields on the FE mesh

FEM

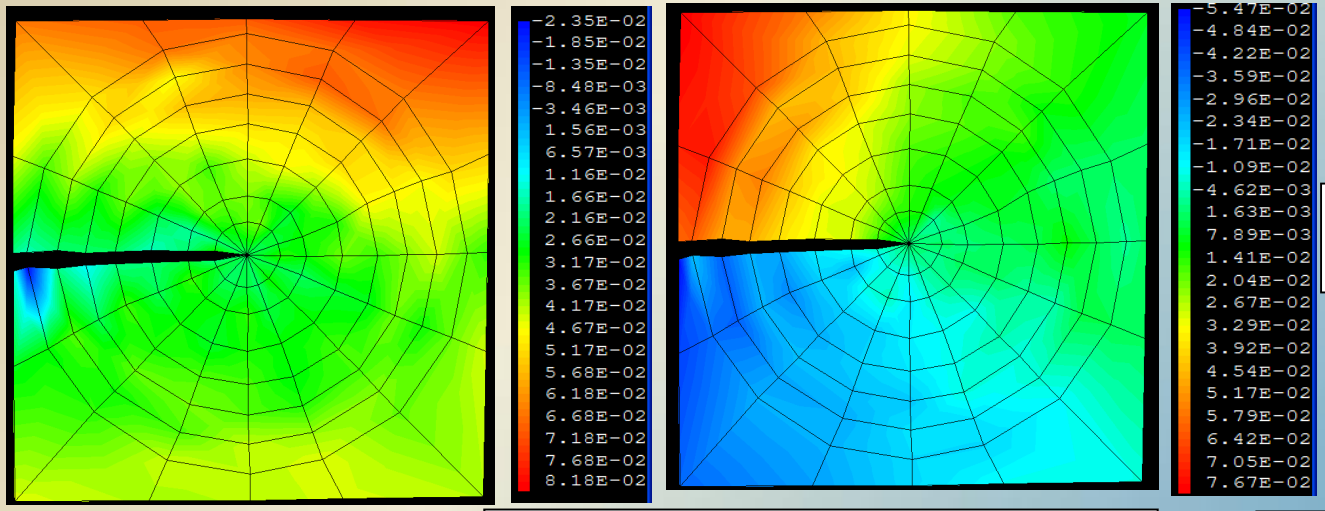


CAST3M



137 nî uds
128 éléments finis

Les approches

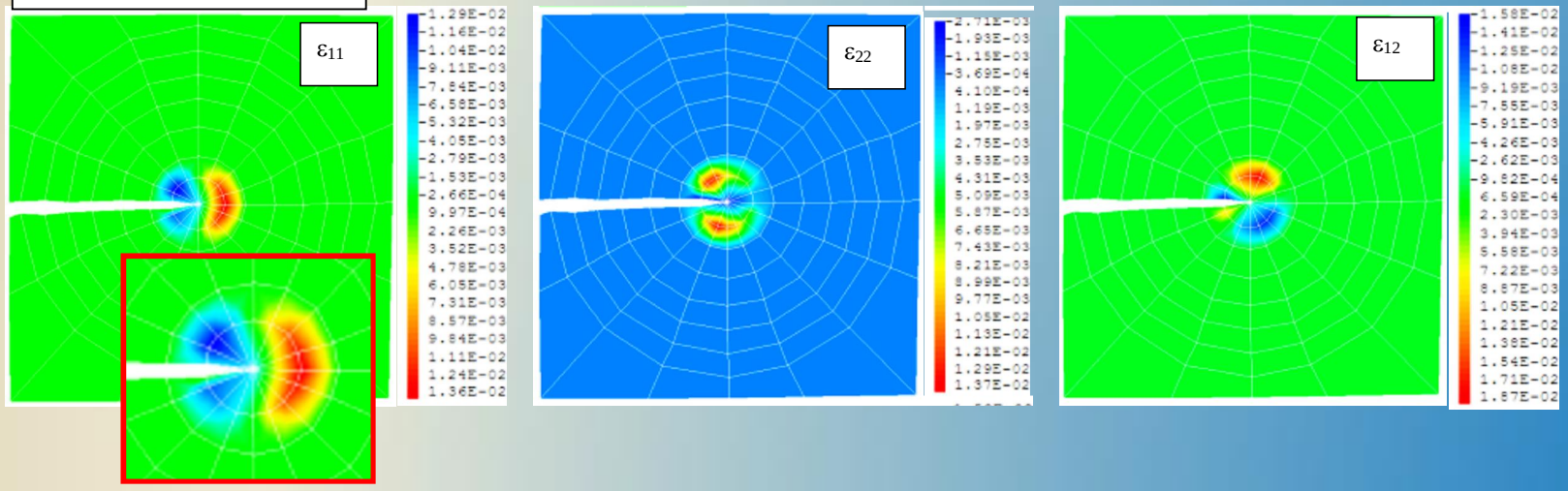


Displacement fields in the study zone

Deformed mesh F = 163.4N

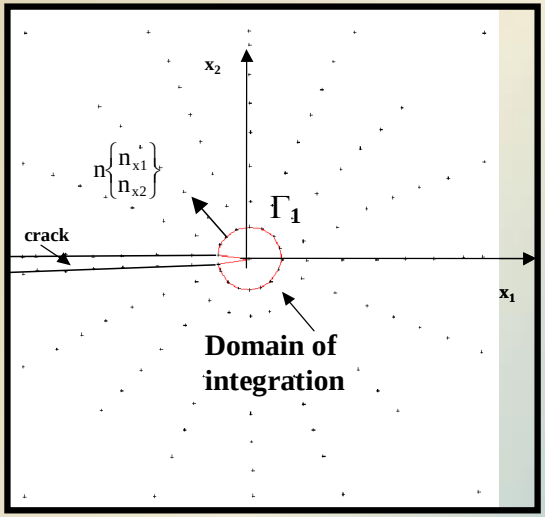
Displacement gradient $\Rightarrow \partial/\partial x_1; \partial/\partial x_2$ → **Strain fields**

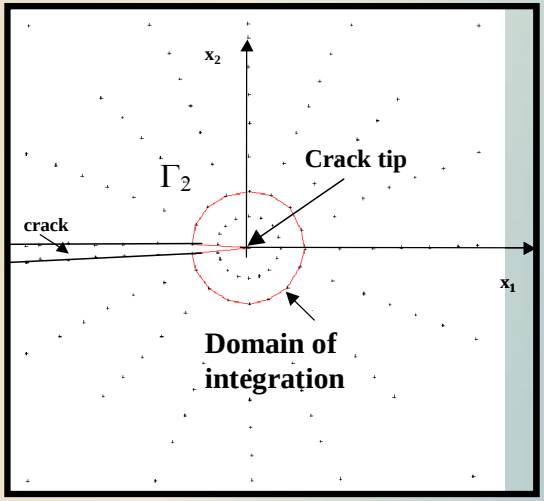
Strain fields



Les approches

Fissuration

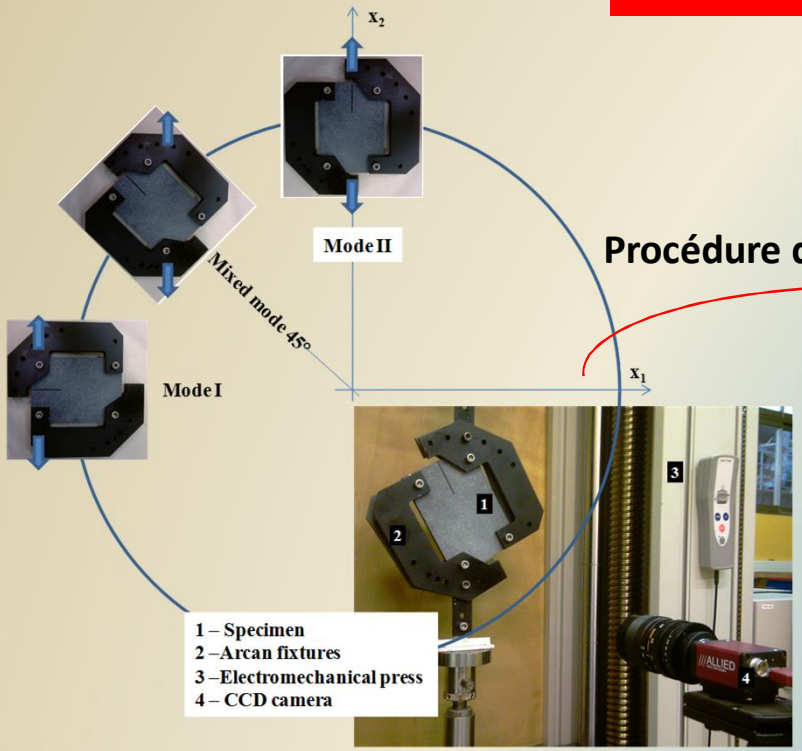




J-integral vs. load

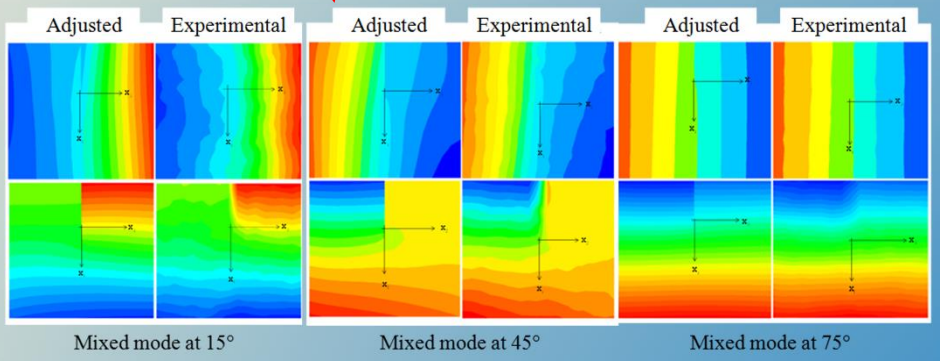
Image	Load (N)	J ï integral (N/mm)	
		Γ_1	Γ_2
300	126	4.69	4.76
400	164	5.41	5.72
500	204	11.40	13.28
700	285	17.77	16.62
800	323	22.14	23.21
850	338	25.21	26.24

Fissuration en mode mixte



Montage expérimental

Procédure d'ajustement (optimisation)



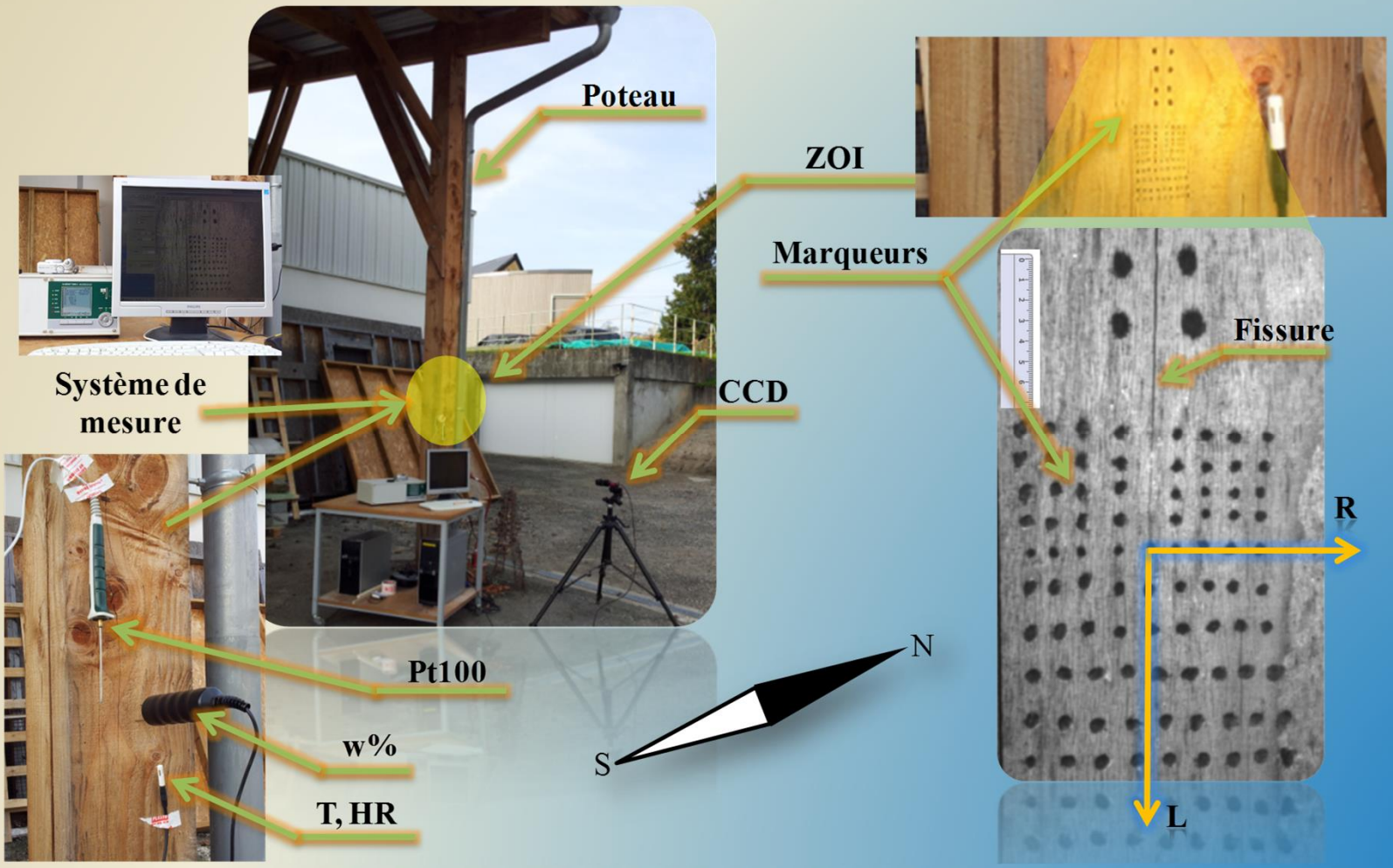
$K_{\alpha}^{(\varepsilon)}$

Douglas fir
MC=11%

Mixed mode	Applied load (N)	$K_I^{(\varepsilon)}$ ($m^{1/2}$)	$K_{II}^{(\varepsilon)}$ ($m^{1/2}$)
15°	277	$5.95 \cdot 10^{-4}$	$1.43 \cdot 10^{-4}$
45°	784	$1.35 \cdot 10^{-3}$	$7.43 \cdot 10^{-4}$
75°	876	$6.91 \cdot 10^{-4}$	$6.58 \cdot 10^{-4}$

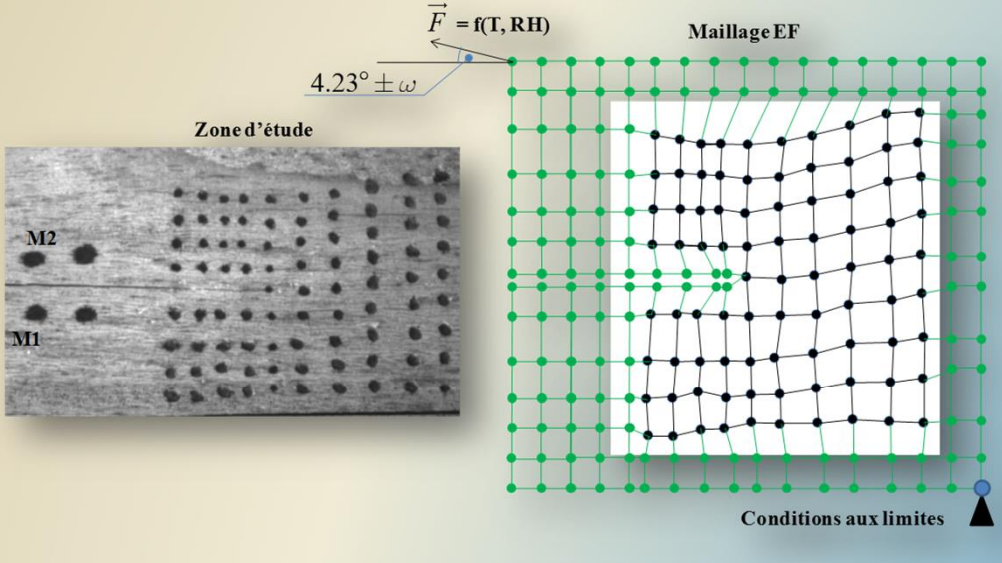
Les exemples

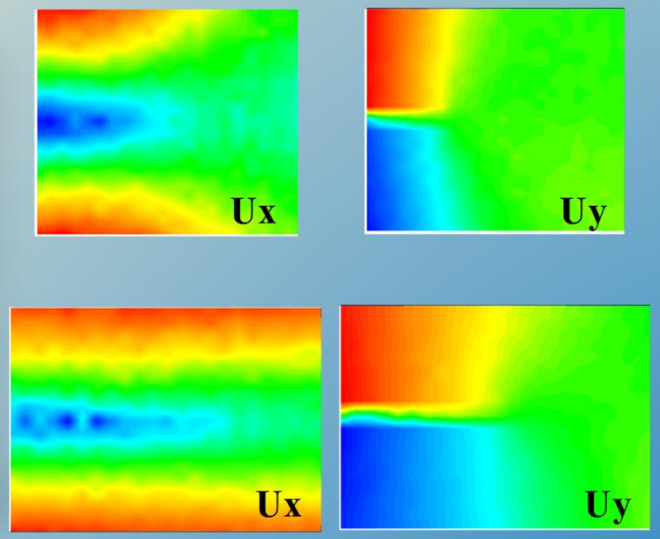
Monitoring



Les exemples

Monitoring





Evolution de l'état déformé

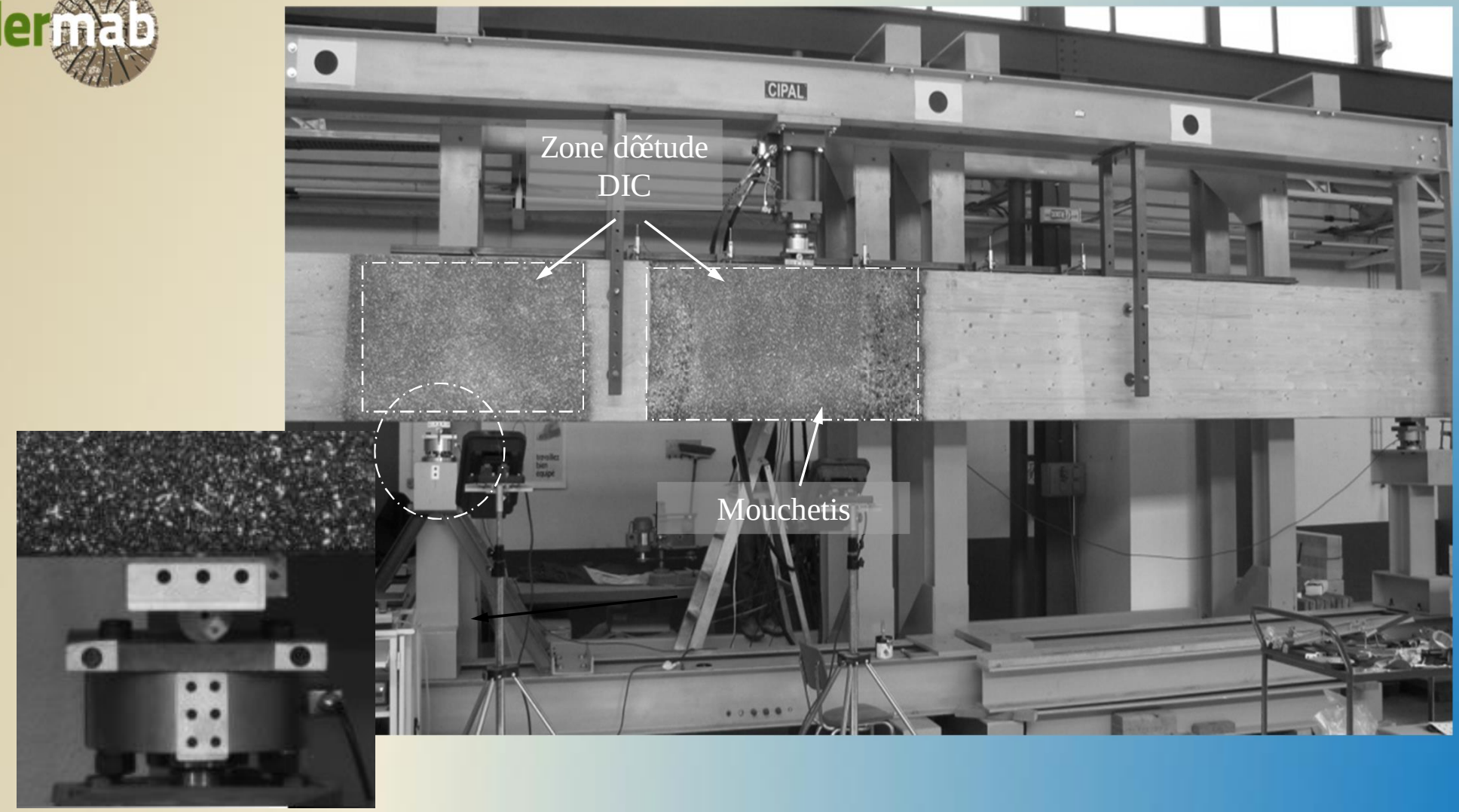
Suivi de la propagation de la fissure

Quantification de l'état mécanique

Champs de déplacement

Les exemples

Compression transversale au niveau des appuis

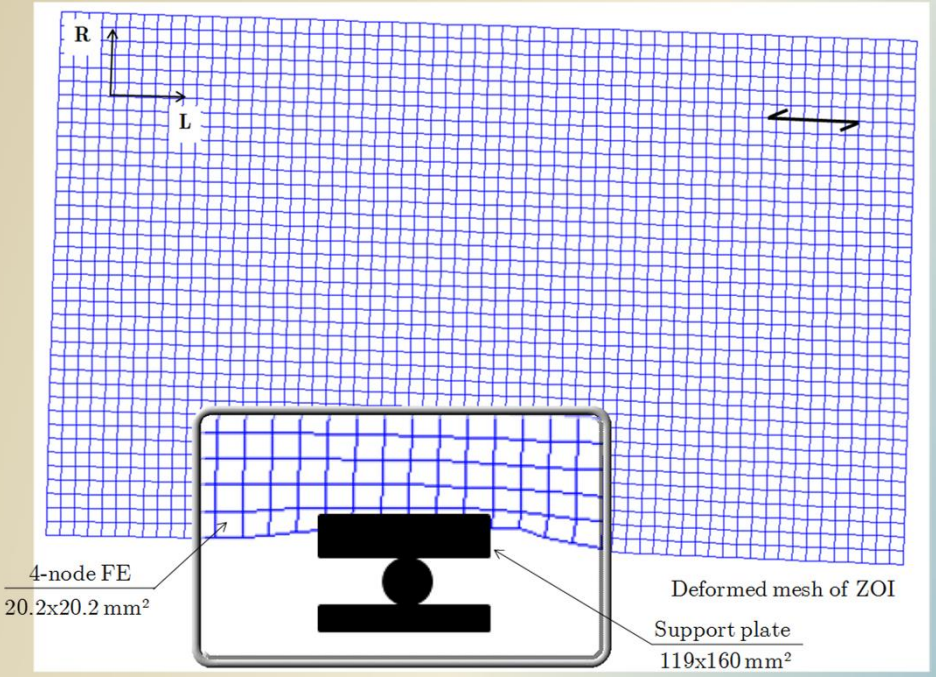


Les exemples

Compression transversale au niveau des appuis

lermab

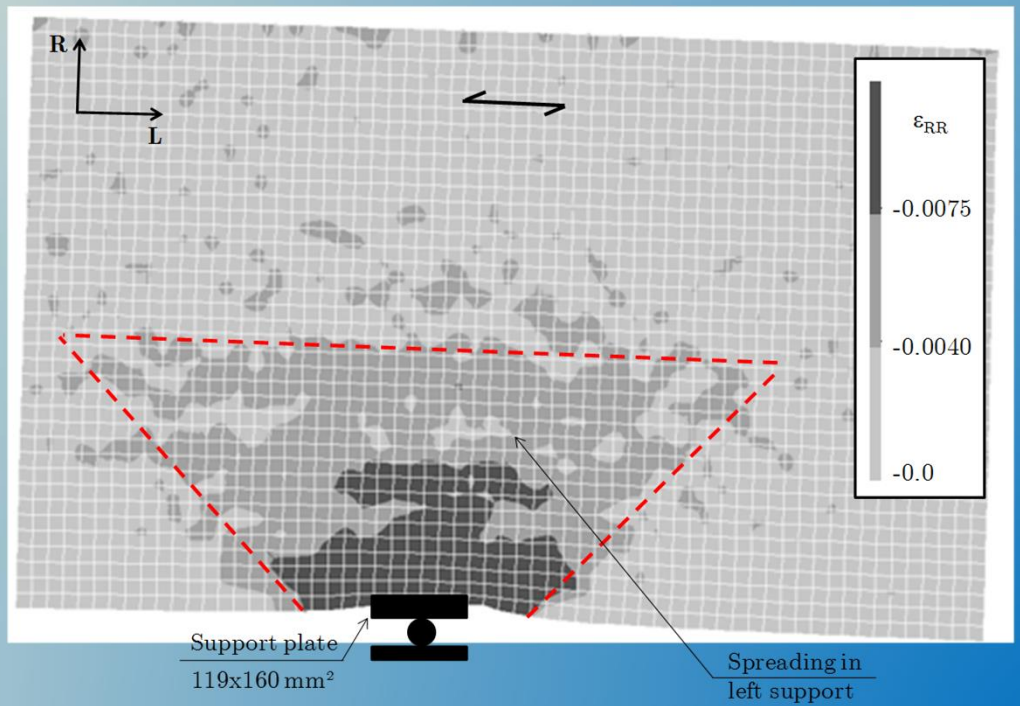
Etat déformé (CAST3M)



- Localisation et quantification du cône de diffusion.

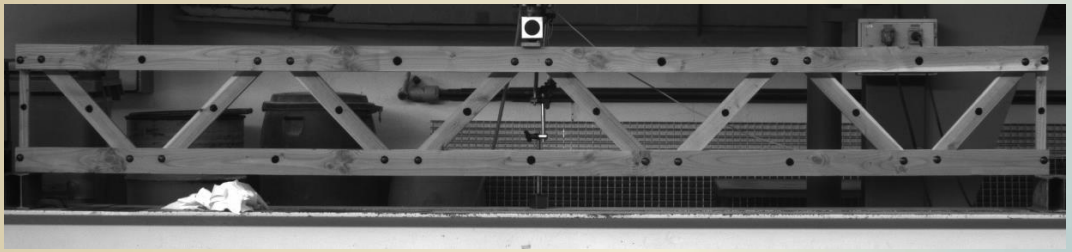
- Renforcement des appuis.

ε_{RR}

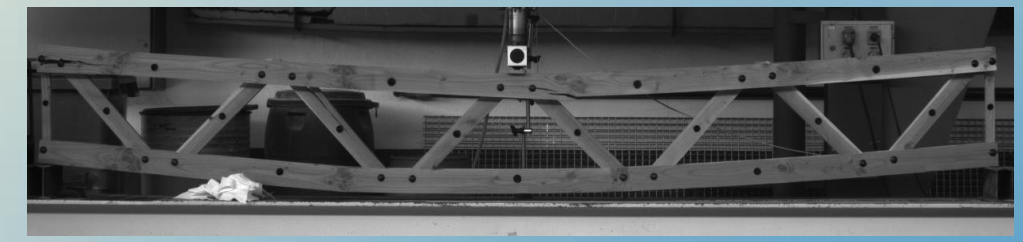


Les exemples

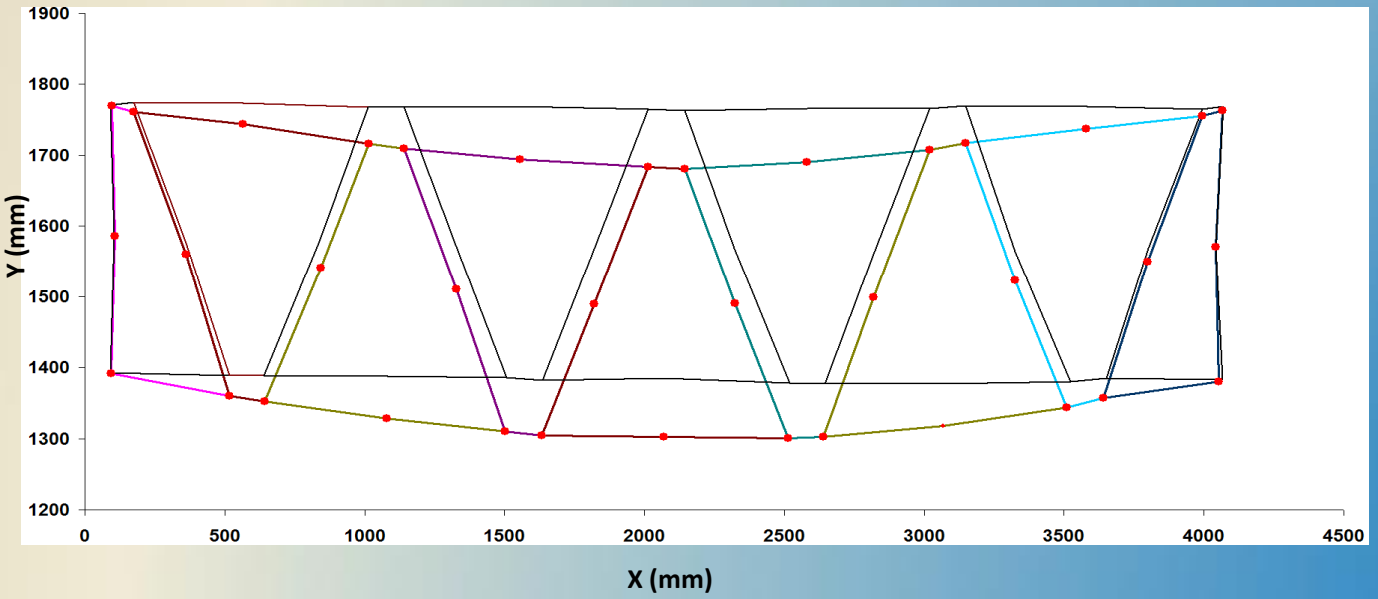
Poutre treillis en bois



Etat initial

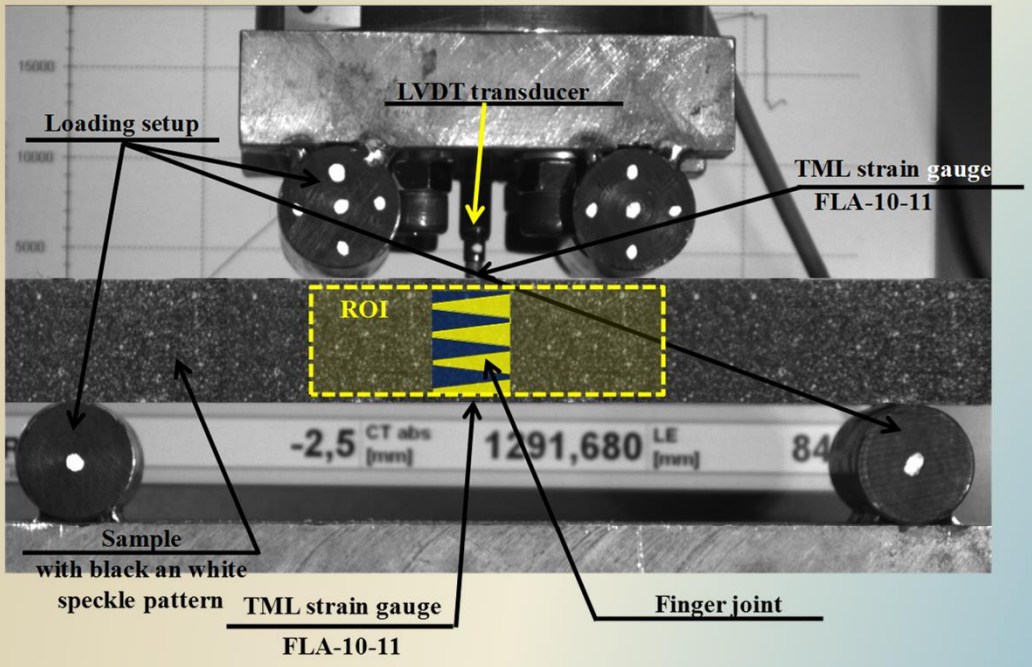


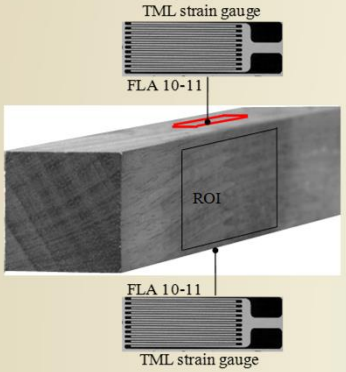
Etat déformé

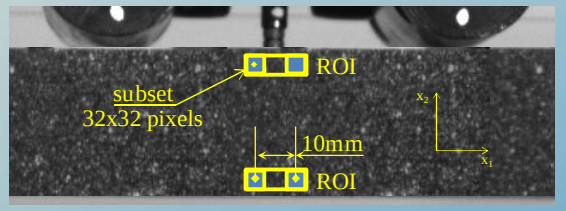


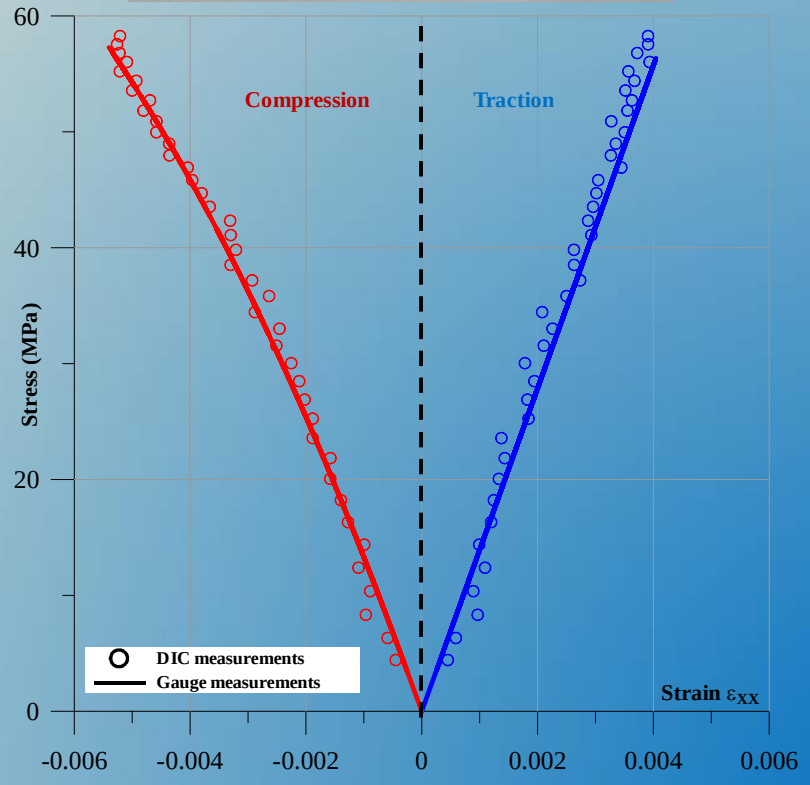
Les exemples

Flexion 4p (Bois abouté)



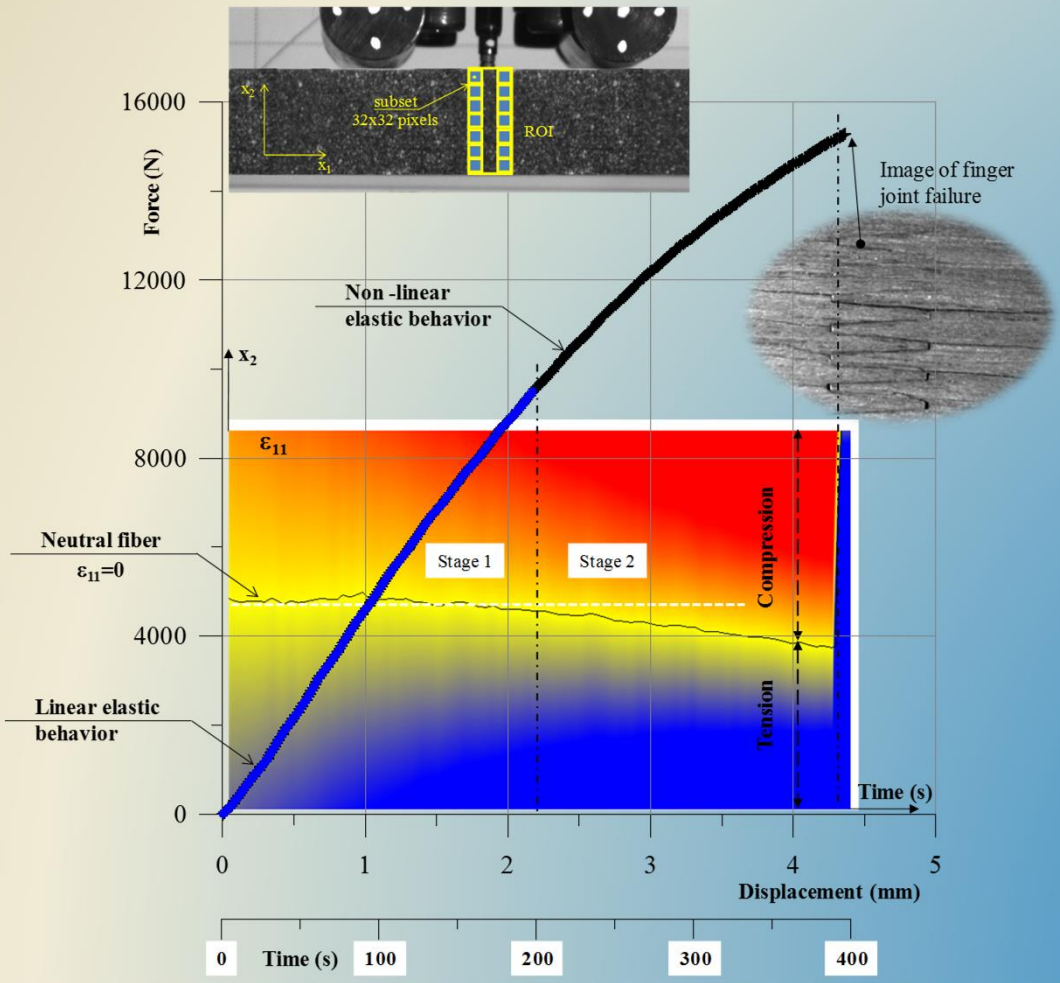






Les exemples

Flexion 4p (Bois abouté)



Merci pour votre attention !