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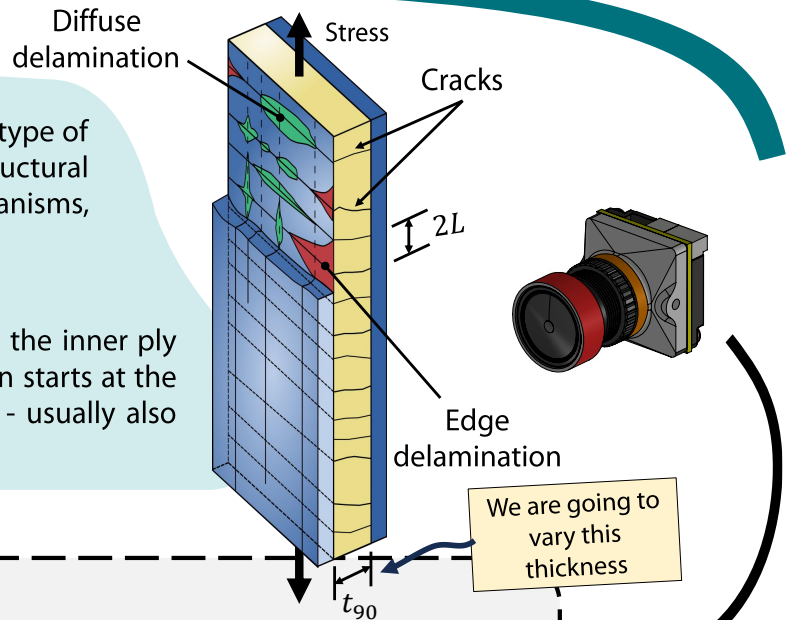
Optical Evaluation of Delamination in Composite Laminates

Background

In composite materials cracks are usually the first type of damage. By themselves, they do not cause structural failure, but they can trigger other damage mechanisms, namely diffuse and edge delamination.

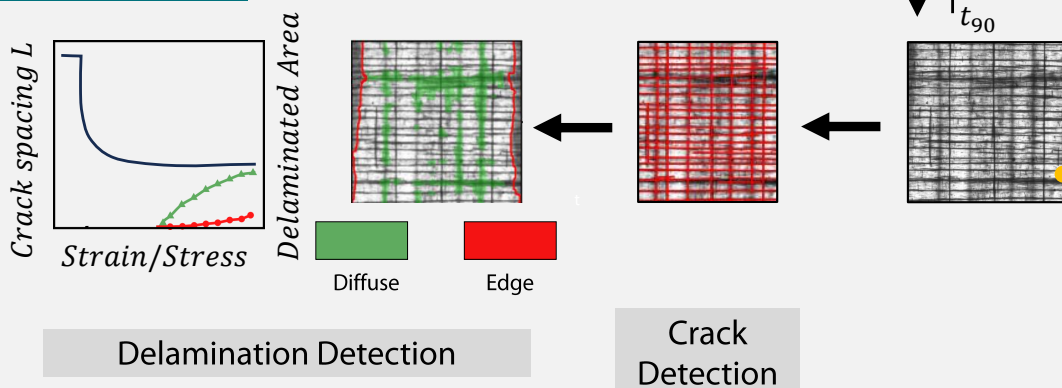
Definition

Diffuse delamination starts at the interface when the inner ply exceeds its load capacity, while edge delamination starts at the crack tips near the edge due to the edge effect - usually also next to a crack.

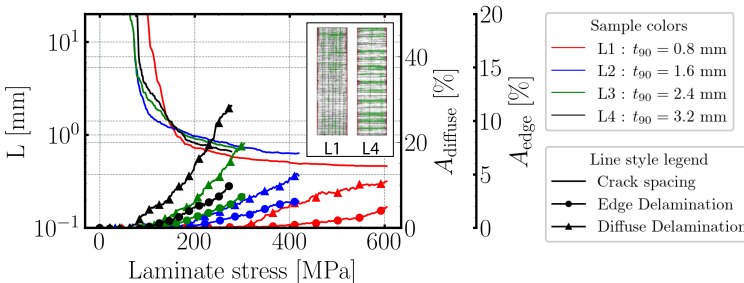


We are going to vary this thickness

Methods



Results



- Cracking starts at higher stresses for thinner plies (L1).
- Bigger delamination areas are observed for thicker laminates.

- Diffuse delamination for thick inner-plies laminates form as bands over the whole width, whereas for thin inner-plies spread locally around crack intersections.



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Glass Fiber Reinforced Polymer

Used in high performance applications

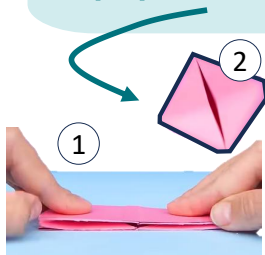
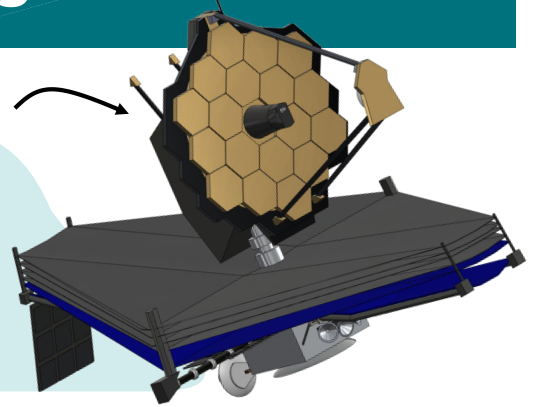
PopUpFEM: Automated Abaqus/Python model generation for jumping cubes

Background

Origami is a traditional Japanese art of paper folding.

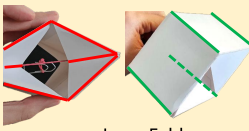
It is not only artistic, but also useful in engineering, since it allows complex structures to be compacted into a small space. At the same time, it can be used for simple and playful science projects. Here, the **Pop Up Boxes** is presented.

James Webb Telescope

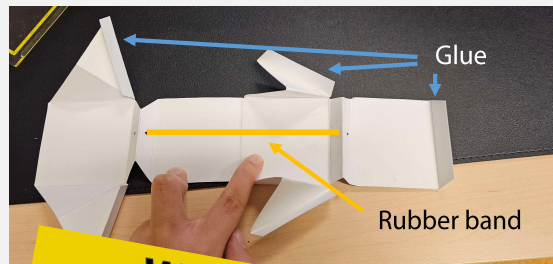


How it works

When the structure is folded, the pre-tensioned spring (elastic band) stretches and stores elastic potential energy. Once released, this energy is rapidly transferred into motion, making the cube "pop" and jump.



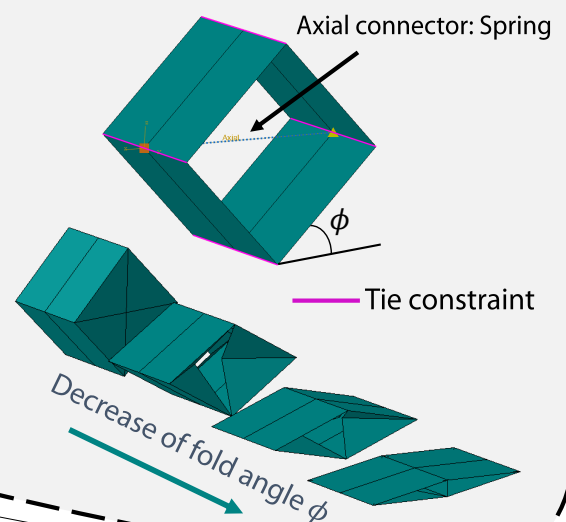
Blue print



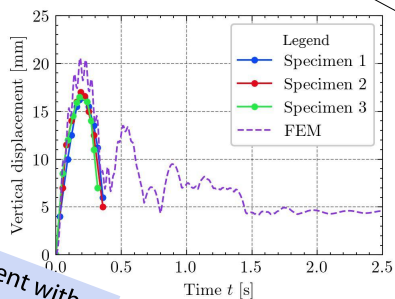
WARNING:
Do ~~not~~ try this at home!

Methods

Model



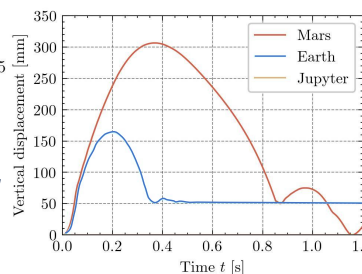
Results



1 Good agreement with experimental results

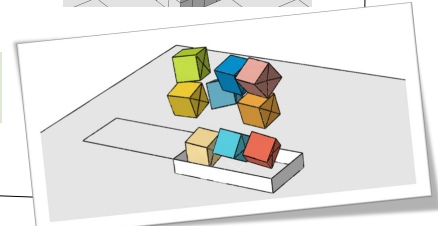
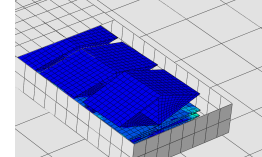


2 How high can it jump on different planets?



With the higher gravity on Jupiter, we would need a much stiffer elastic band

3 We can stack the boxes to jump even higher!



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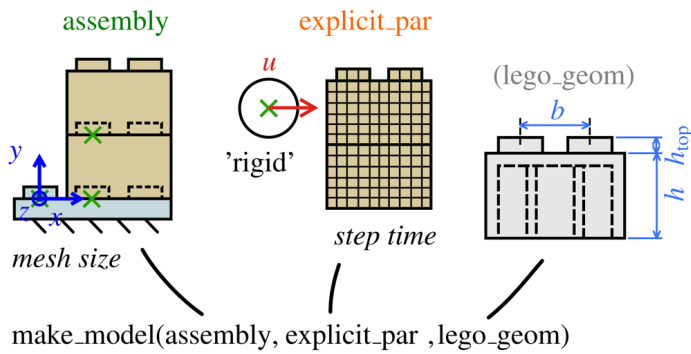
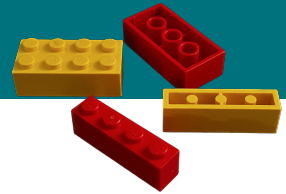
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Code and more examples:
github.com/VascoPires/PopUpFEM

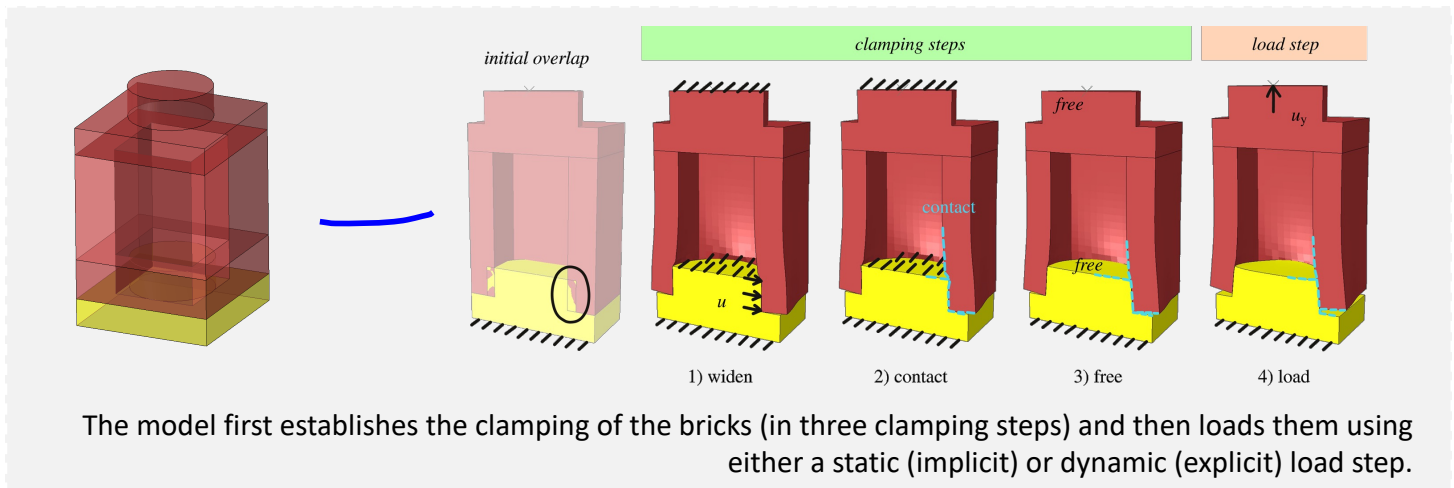


BrickFEM: Automated Abaqus/Python model for simple Lego® sets

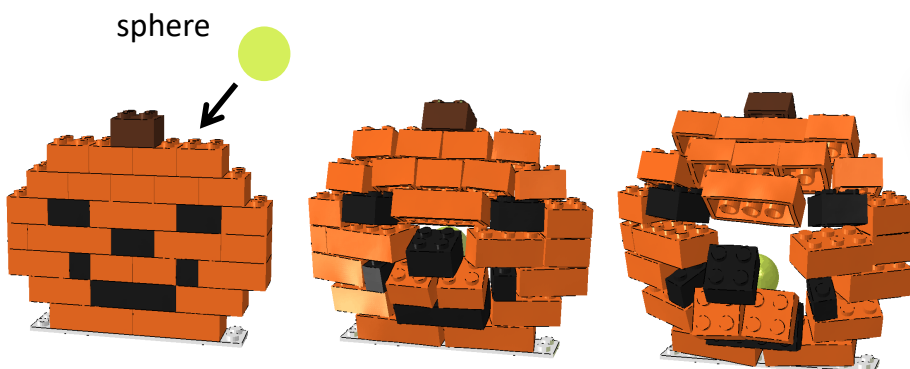


BrickFEM automatically generates, runs, and evaluates models of small Lego sets in the finite element software Abaqus. The model can contain Lego bricks, plates, tiles, and base plates.

To create and run a model, one must specify how the bricks are assembled, how the model is loaded, and the Lego brick dimensions.

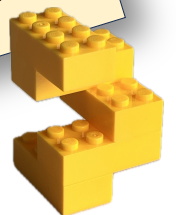


The model first establishes the clamping of the bricks (in three clamping steps) and then loads them using either a static (implicit) or dynamic (explicit) load step.



Example simulation: A pumpkin that is hit by a (green) sphere with 40 m/s.

You got an idea for other cool Lego models made with regular bricks, plates, tiles, and base plates? Send me an email with a picture of the set and tell me what should happen to it!

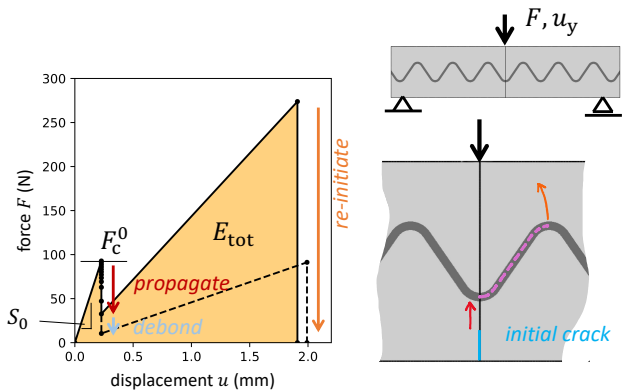


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Code and more examples:
github.com/mpletz/brickfem



Improving the Flexural Stiffness of Layered Materials Using Wavy Interlayers

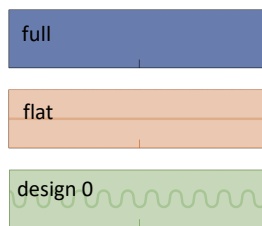
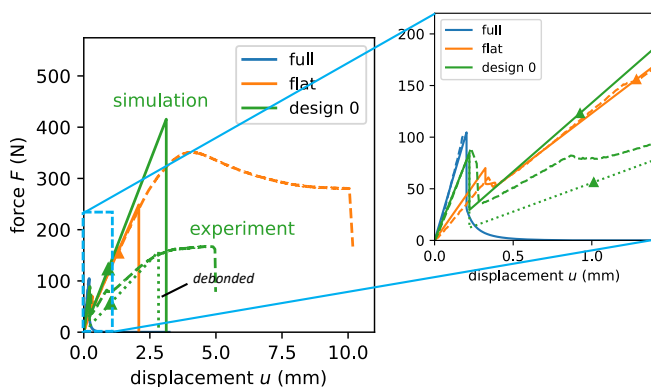
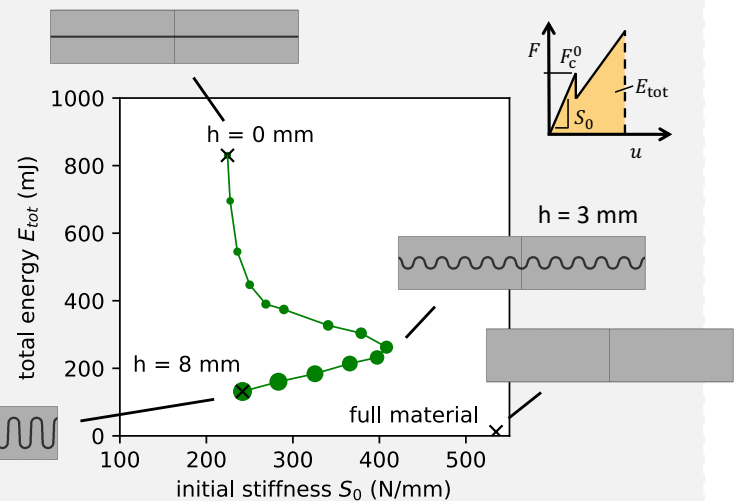


Brittle materials are sensitive to defects which can trigger sudden failure. Introducing "soft" interlayers can stop the propagation of a crack, which requires more energy to further propagate the crack from the interlayer.

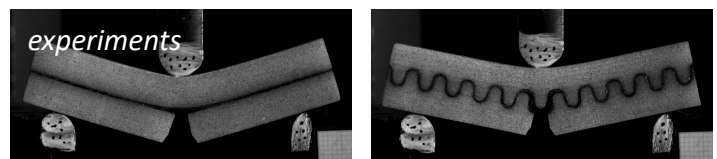
Thereby, these "soft" interlayers increase the toughness, measured here by the total energy E_{tot} . However, compared to the full material (no interlayer), the layered structure has a lower initial flexural stiffness S_0 .

We use a linear elastic finite element (FEM) model with incremental crack propagation to study the influence of the wave shape on E_{tot} and S_0 .

For flat interlayers (wave height $h = 0$), E_{tot} is much higher than for the full material, but S_0 is considerably lower. Introducing waves reduces E_{tot} but increases S_0 up to a certain point (in this case, at $h = 3$ mm). This demonstrates that using wavy soft interlayers can result in tough structures that are also stiff under flexural loading.



A comparison to the test results shows qualitative agreement but also highlights the limitations of using a linear elastic material in the simulation. One of the next steps will be to account for the non-linear material in the model.



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C. Waly, M. Pletz, T. Volders, M. Contino, F. Passoni, D. Ruffoni, L. Andena, F. Arbeiter, Materials & Design (2026) 115887.

