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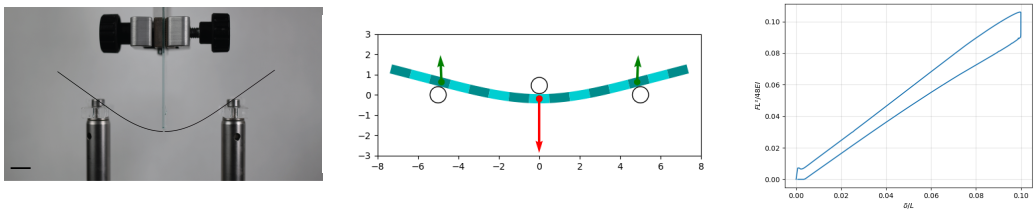

Fig. 1: Left : Picture of the experimental manipulation. Center: illustration of one arbitrary step of the simulation, showing the forces applied on the indented fiber (arrow colors indicate the stick (red) or slip (green) regimes). Right: plot of the deflection force as a function of the indentation for a full indentation cycle, computed with our simulator.

The three-point bending test is a classical test, widely used to determine the bending modulus of a rod. However, the role of friction on this single test has been scarcely studied [1]. Our objective in this work is therefore to investigate the role of friction in this archetypical test in both the small and large deflection regimes by combining experimental and numerical studies.

On the one hand, we design a three-point bending experimental setup with fixed – non-rolling – supports, with precision measurements of the forces applied at the deflection point together with the corresponding displacement of the fiber along one of the two supports. On the other hand, thanks to our carefully validated numerical model coupling a rod model to frictional contact [2], we manage to predict accurately the geometry and forces of the system in the full nonlinear regime.

By comparing the numerical results with the experimental ones and expanding on a wider range of parameters, the role of friction is quantified and analysed, extending the usual rolling three-point bending test. A mathematical study is also conducted, based on the numerical observations to complement the results. Finally, we demonstrate that the frictional three-point bending test provides a simple way to measure the friction coefficient of a slender structure.

References

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