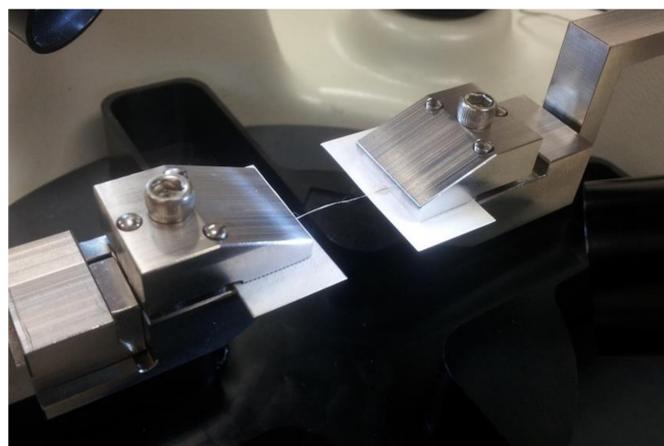
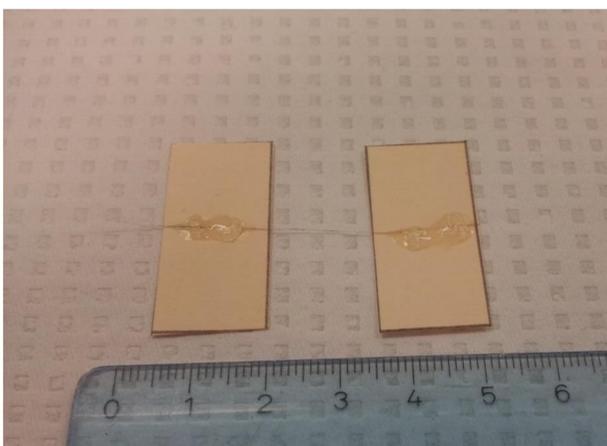


Overview

Specimen fixation and strain measurement can be a challenge for the mechanical testing of both soft and stiff materials. This report outlines the techniques and results of testing done on a flax fibers, where the specimens are prone to breakage with clamp fixation and the strain to failure is relatively low (<2%).

Specimen Fixation

The specimens used for this testing were single bundles of flax, each composed of a group of flax fibers. The bundle diameters were about 20 μ m. Previous attempts to clamp the bundles in steel jaws had resulted in specimen breakage due to mechanical damage. Attempts to clamp the bundles in soft plastic jaws had resulted in insufficient grip strength to prevent specimen pull-out. The specimens were able to be successfully tested by gluing the fibers to cardboard tabs with cyanoacrylate glue. The tabs were fixed at 15mm apart prior to applying the glue in order to fix the zero specimen length.



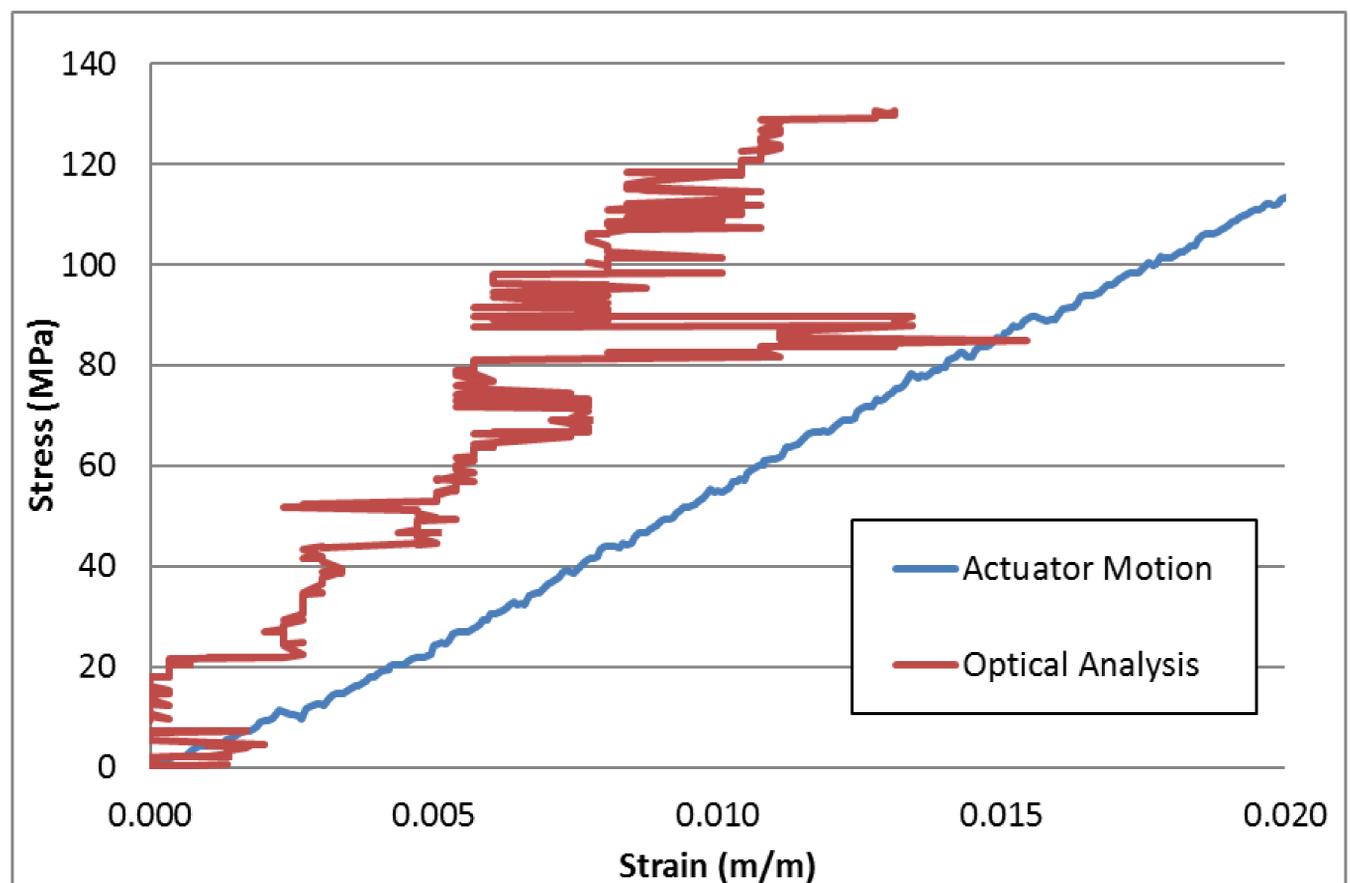
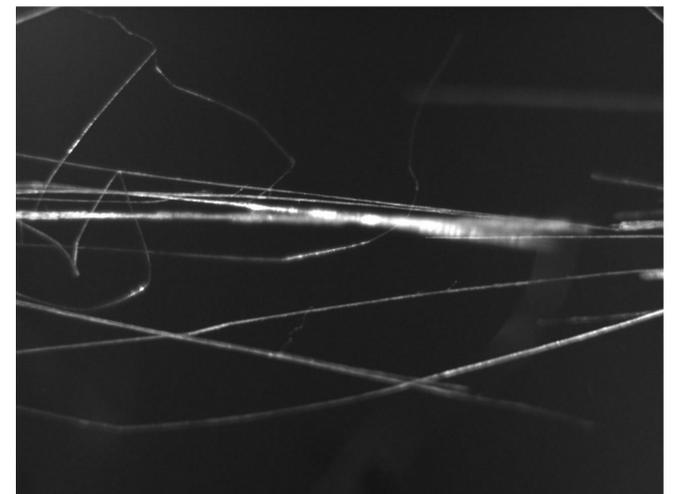
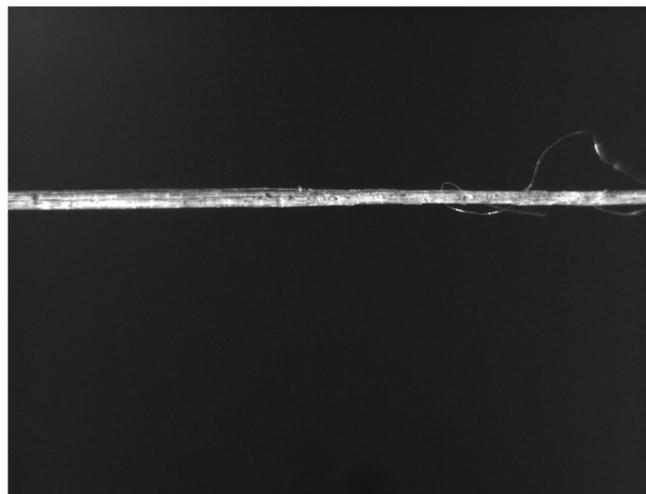
Once mounted in the UStretch test system, a test protocol with a 400mN preload and a constant velocity stretch of 15 μ m/s until failure was applied. Force/displacement data and time-correlated images were collected at 15Hz during the test.

Tension Testing of Stiff Fibers

Results

Stress and strain were calculated for each of 3 tests using the force and displacement data collected. TO verify the strain values, the motions of the fiber were analyzed using the image analysis toolkit. The image analysis resulted in lower strains than the actuator displacement-based strain data. This is not surprising since some of the actuator displacement could have resulted in system deflection, stretching of the cardboard mounting tabs, or specimen slippage.

In all 3 cases, the specimens failed at approximately 500 μ m displacement and 5N of force. The resulting moduli for the 4 test (based on image analysis-based strain data) were 10.8, 10.5, 7.8, and 6.3MPa.



Conclusions

This testing shows that the UStretch is capable of measuring the stiffness of stiff fibers and that the image analysis toolkit is important for verify specimen strains.

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