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# Experimental investigation of polymers under cyclic loading

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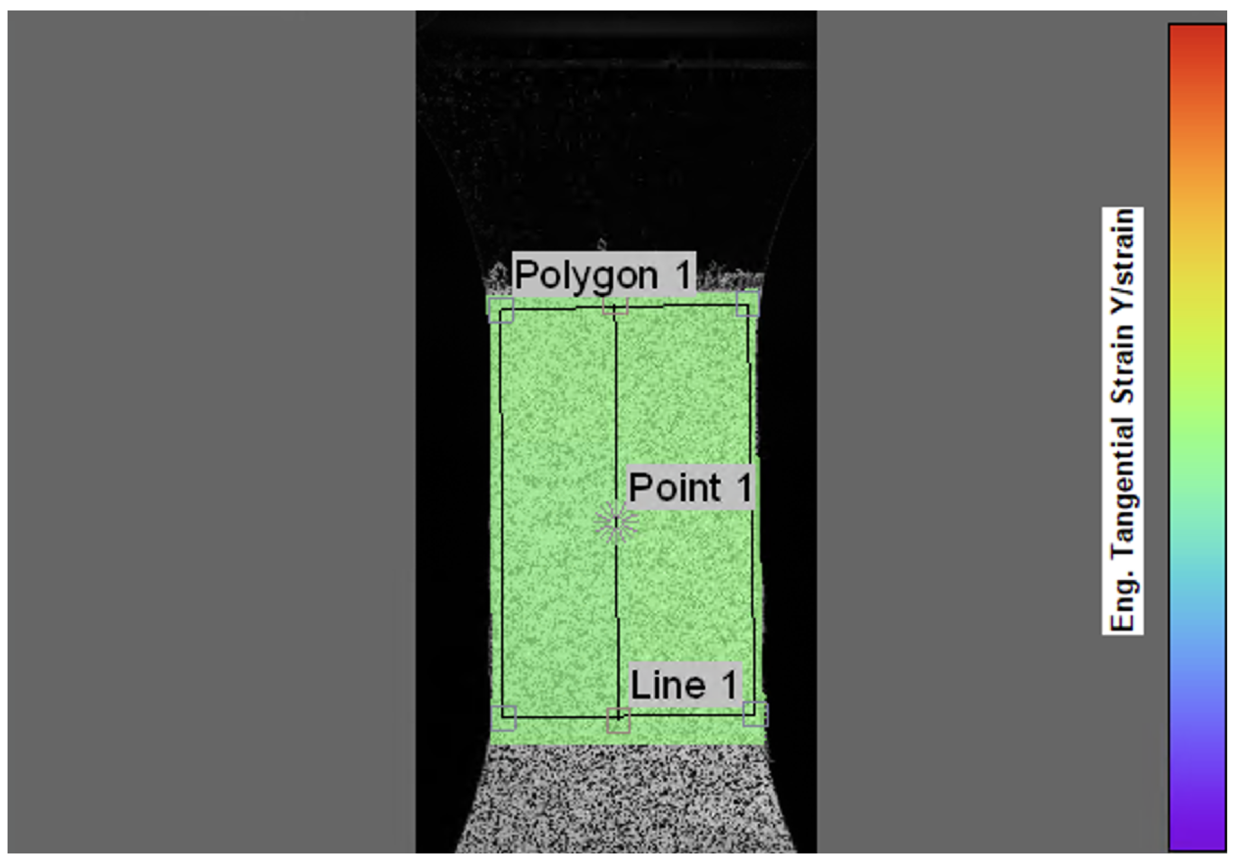
## Motivation

Polymeric materials in engineering applications often experience repeated rather than static loading. Their time-dependent deformation leads to effects like energy dissipation, softening, and permanent strain. These cyclic behaviors require dedicated experiments for realistic characterization. In this study, such effects were examined using polycarbonate as a representative material.

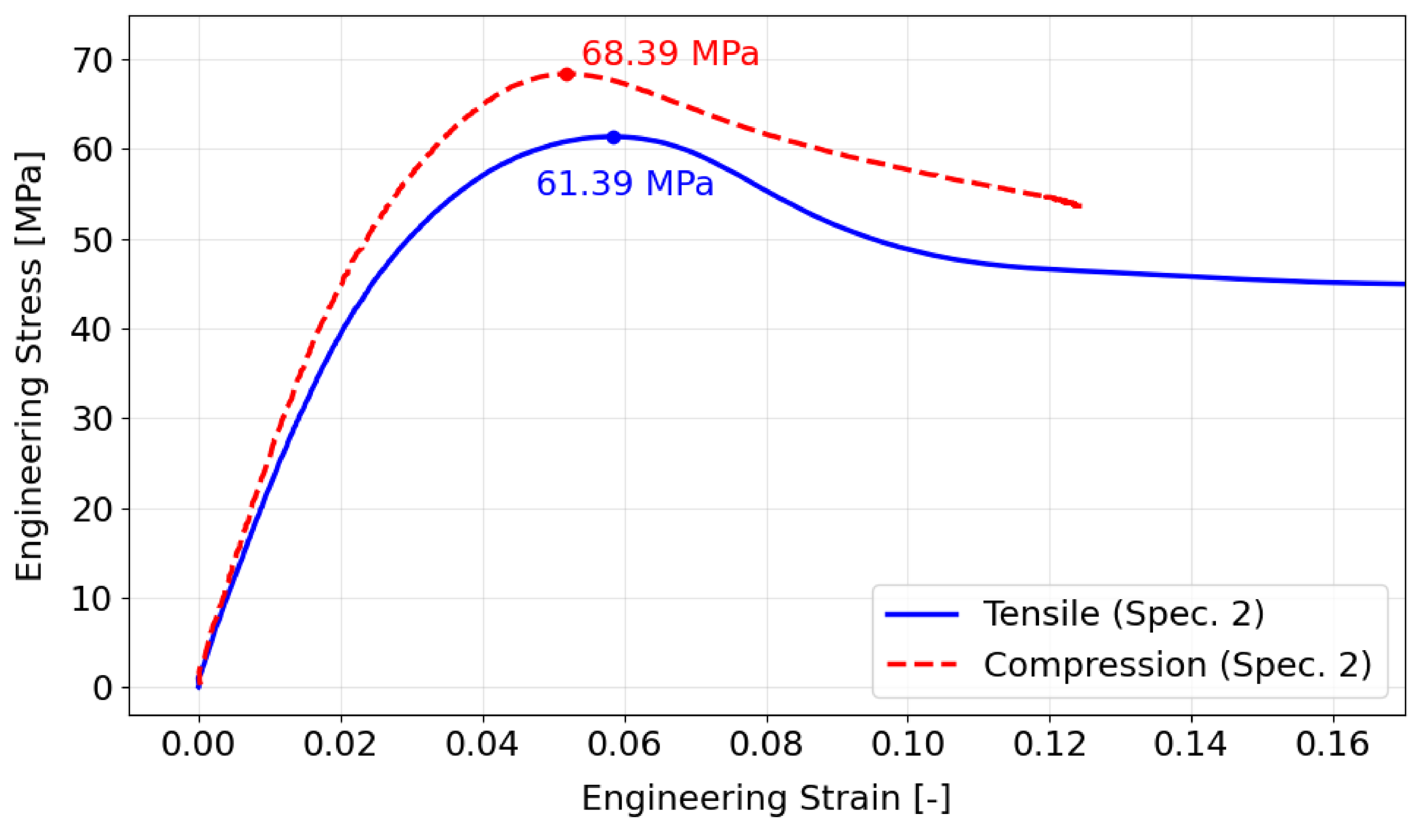
## Experimental Methodology

Tensile tests were conducted under displacement and force control using a universal testing machine. Strain fields were recorded optically via digital image correlation with a high-resolution camera and synchronized image acquisition. Three specimen geometries were tested under standardized conditions, with torque-controlled clamping to ensure repeatability. Mechanical quantities such as stress, strain, and dissipated energy were derived from synchronized force and displacement data.



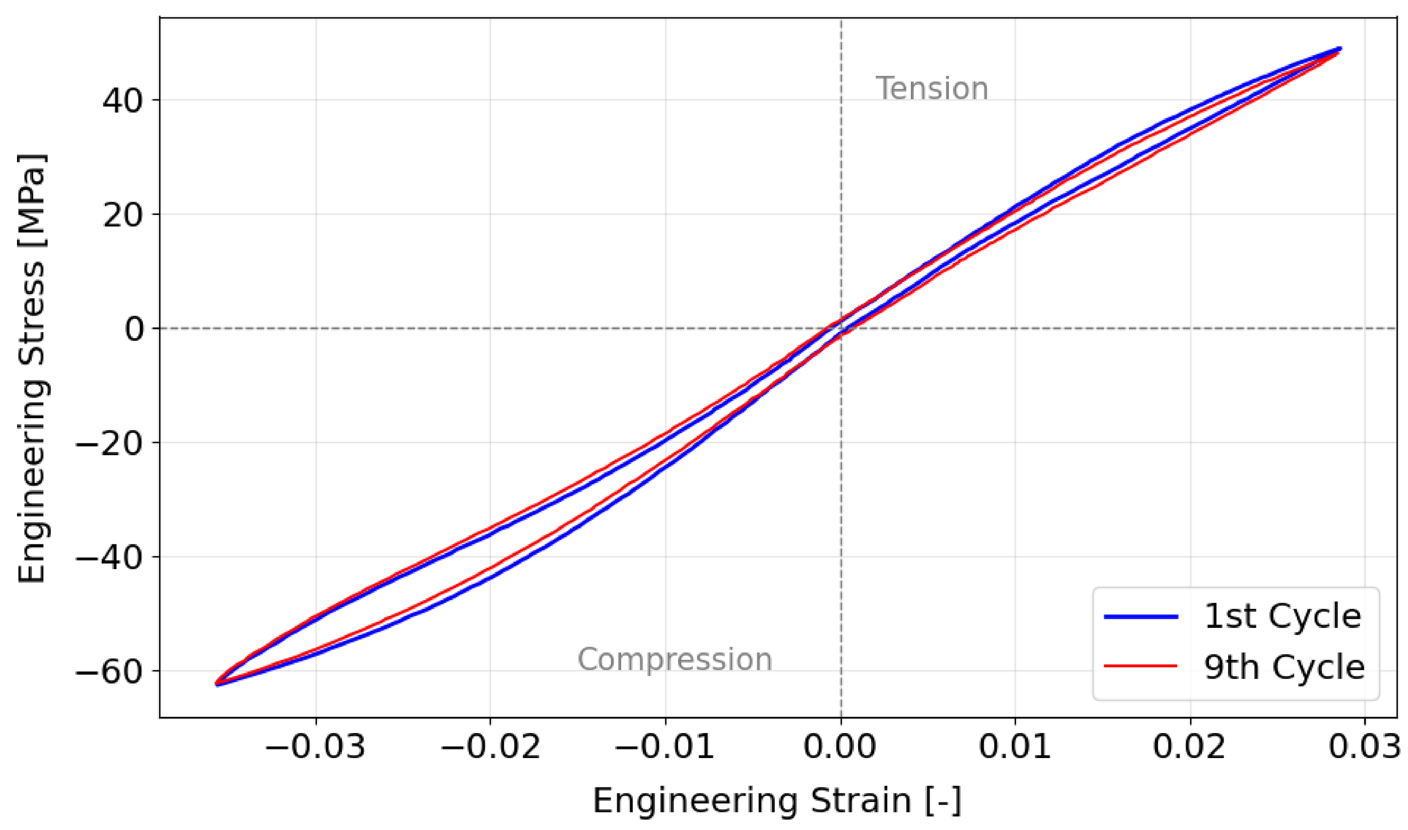

## Monotonic Testing

Monotonic tensile and compressive tests on polycarbonate revealed typical nonlinear stress–strain behavior with yielding and softening. The material showed pressure sensitivity, exhibiting different responses in tension and compression.

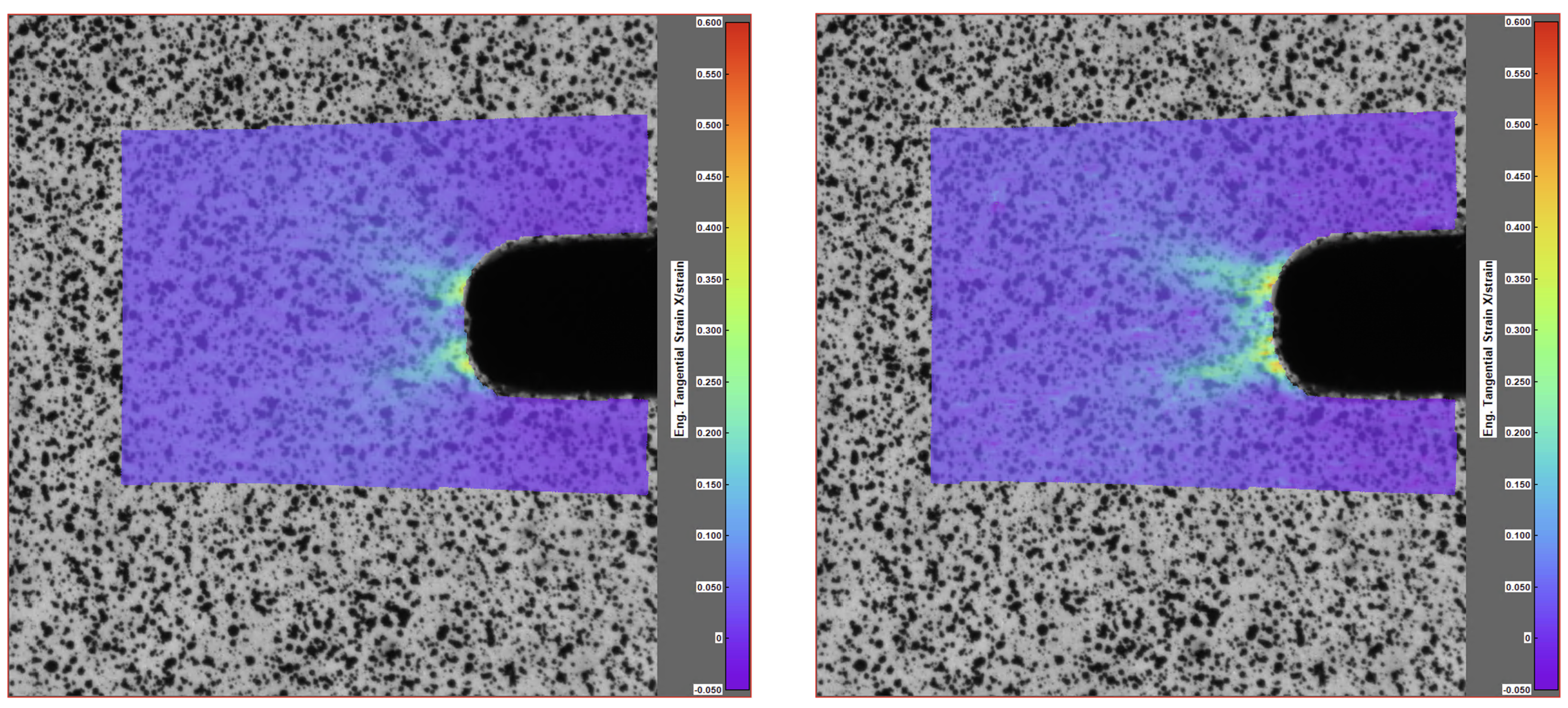



## Cyclic Testing

Under symmetrical tension–compression and displacement-controlled loading, the resulting hysteresis loops remain consistent, showing only slight reductions in peak stress—typical of cyclic softening.




Fracture-mechanical tests under uniaxial tension and displacement control revealed progressive strain localization at the notch. Shown are strain fields after loading in cycle 1 (left) and cycle 10 (right).



## Conclusion and Outlook

The results reveal fundamental cyclic behavior and show how amplitude, loading mode, and geometry influence deformation—offering a basis for 3D-DIC or simulation.

## References

[1] Rabinowitz, S. and Beardmore, P. Cyclic deformation and fracture of polymers. In: *Journal of Materials Science*, 1974.