
Laddering in a knitted fabric

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Abstract

A knitted fabric is a meta-material composed of a series of loops, called stitches, which are intertwined from a single thread. This network of loops is stabilized by its topology. Knits are all at once highly flexible, stretchable, lightweight, and strong. These remarkable mechanical properties emerge from their architecture, controlled by the deformation of the loops on one hand and solid friction at the thread crossings on the other.

Following a localized break in the thread that makes up the fabric, the network of loops develops a topological defect that can propagate along the column of stitches where the break occurs, a process known as "laddering". This is the primary cause of failure in stockings and tights. In practice, however, some ladder defects propagate through the entire length of the knit, others stop after a finite distance, and some do not propagate at all. Why does this happen? What governs the propagation speed of these defects? We have conducted experiments and numerical simulations to address these questions.

In this talk, after shedding light on this damage phenomenon, I will present our research and the key results we have obtained, offering insights into the mechanisms behind ladder propagation in knitted fabrics.

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