Improved Tensile Tester (Experimental Results)

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Activity Report

1 Research Question

The primary goal of our improved uniaxial tensiometer system is to increase system accuracy by implementing some key features that align with stakeholder requirements. Some other improvements were made to ensure ease-of-use for individuals with no prior knowledge of electronics or software programming. To demonstrate the accuracy of our system, we tested our system on two different types of material (latex and nitrile) and compared the values of Young's modulus and ultimate tensile strength computed from the stress-strain curve to known values for these materials.

2 Experimental Results

1) Stress-strain curve for latex glove (See Figure 1).
2) Stress-strain curve for nitrile glove (See Figure 2).
3) Table summarizing key metrics (Young's Modulus and Ultimate Tensile Strength) derived from stress-strain curves compared to known values from the original research paper (See Table 1).

These figures illustrate what ideal trials look like when operating our system. Notice there is a clear linear portion of the graph to calculate Young's Modulus from. For example, in Figure 1, it could be derived by picking the data point around approximately (3, .5) and the origin (0,0) and applying the slope formula. Ultimate tensile strength would be derived from the highest data point in the curve. For these two curves, there were approximately 60-70 data points in total.

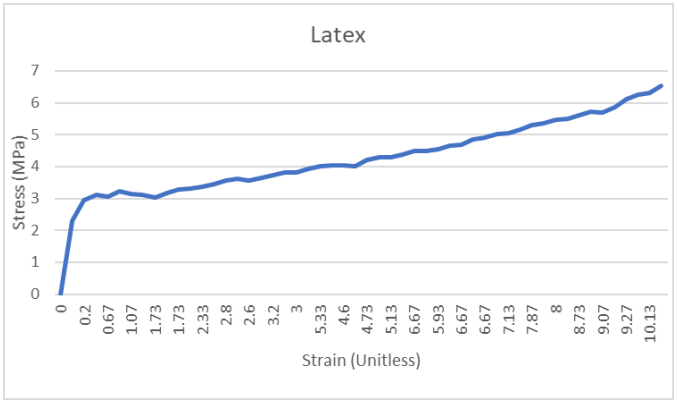

Figure 1. Stress-strain curve derived from our system for Latex glove sample

3 Data Analysis

Upon first glance the results from our system seem to deviate greatly from the known values; however, there are other sources that indicate much different values for Young's Modulus and Ultimate Tensile Strength of both latex and nitrile material. Because of this, conclusions shouldn't be made about system accuracy because of the current "known" values from the article. Rather, a more broad approach

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Metric	Sample	# Trials	Our System	Known Value	Error
Young's Modulus	Latex Glove	3	730 ± 10 kPa	740 ± 10 kPa	$\pm$?
..	Nitrile Glove	3	9.5 ± 0.1 MPa	2.4 ± 0.2 MPa	$\pm$?
Ultimate Tensile Strength	Latex Glove	3	6.1 ± 0.1 MPa	3.3 ± 0.1 MPa	$\pm$?
..	Nitrile Glove	3	12.7 ± 0.1 MPa	4.4 ± 0.1 MPa	$\pm$?

Table 1
Summary of experimental results from multiple trials

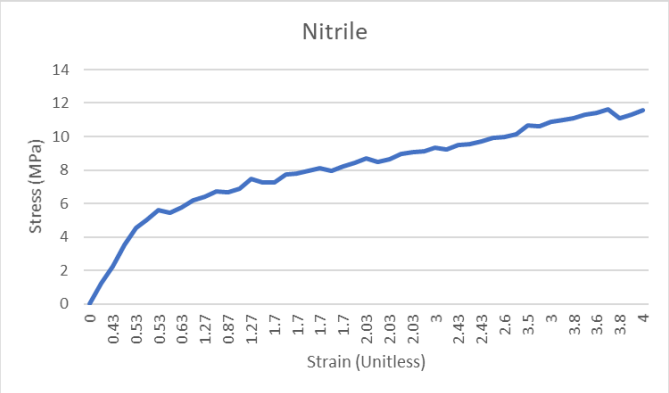

Figure 2. Stress-strain curve derived from our system for nitrile glove sample

should be taken to find consistent known values across numerous sources. For our system, the curves/calculations for both materials were consistent across multiple trials, which is more important in the current level of the design process. It's a rough system at this point, so consistency across multiple trials are an ideal outcome.

Based on our results, we can say that the addition of the crank/improved distance sensor was a success. The curves generated from our systems were smooth and illustrated clear regions from which to derive Young's Modulus and Ultimate Tensile Strength from. However, there are still limitations. The smoothness of the curve is based upon the number of data points collected, which is directly based on how long a trial is conducted for. During an ideal trial, the user would crank at a slow and controlled pace until the sample breaks. If the user cranks at too fast of a pace, there wont be enough data points to generate a smooth curve which would greatly impact final calculations. Additionally, during our trials we occasionally had a sample escape from the clamps before there was a fracture which resulted in a failed trial.