Automatic Uniaxial Tensiometer Experimental Results

Farid Barak, Alex Reyes, Lee Kihyun, Nour El Banna

Activity Report

1 Research Question

The primary goal of our improvements to the uniaxial tensiometer system is to increase system accuracy by completely automating the tensile test. 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. The result allowed our accuracy to improve by 23%.

2 Experimental Results

Upon testing our system with multiple samples of nitrile and latex, below is our results we established.

1) We present our Stress-strain curves for both nitrile and latex glove (See Figures 1 and 2).
2) Data 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 2).
3) Instrument survey from multiple users using the Likert scale (See Table 2).

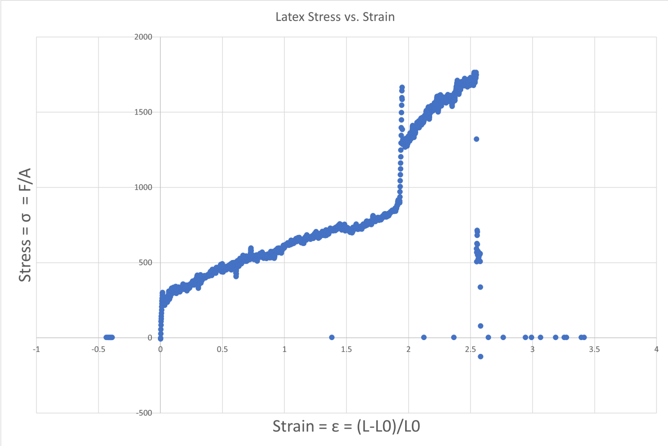

Figure 1. Stress-strain curve derived from our system for Latex glove sample

Figure 2 shows the stress strain curve results of the improved tensiometer for the nitrile glove sample. The collected data is close to the expected results for the material. The two outlier points in the data plots represent a slight error in collecting the data associated with the stepper-motor's pulley system.

3 Data Analysis

It is evident that our system can provide fairly accurate results based on our data obtained from the materials stress-strain curve analysis. A few minor quirks that were presented are "stalls" occurring during the testing process.

• *Farid Barak.*
E-mail: fbarak@albany.edu,
• *Alex Reyes.*
E-mail: areyes7@albany.edu,
• *Lee Kihyun.*
E-mail: klee23@albany.edu,
• *Nour El Banna.*
E-mail: nelbanna@albany.edu,

Electrical & Computer Engineering, University at Albany.

PP-2017 V2.1

Metric	Sample	# Trials	Our System	Known Value	Error
Young's Modulus	Latex	6	700 kPa	740 ± 10 kPa	$\pm 5.54\%$
..	Nitrile	6	2.1 MPa	2.4 ± 0.2 MPa	$\pm 12.5\%$
Ult. Tensile Strength	Latex	6	3.5 MPa	3.3 ± 0.1 MPa	$\pm 6.06\%$
..	Nitrile	6	4.1 MPa	4.4 ± 0.1 MPa	$\pm 6.81\%$

Table 1
Summary of experimental results from multiple trials

Metric	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Securing material to the clamps is quick and easy	0	0	0	2	5
Calibration process is simple and straightforward	0	0	1	1	5
Acquiring data is simple and straightforward	0	1	1	1	2
Importing the data for analysis is quick and easy	0	1	1	3	2
The system did not require me to learn any new tools	0	0	1	3	3

Table 2
Instrument Survey Using the Likert Scale

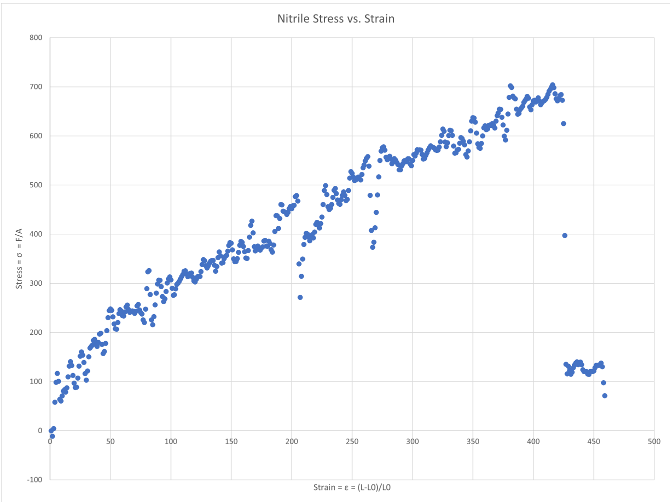

Figure 2. Stress-strain curve derived from our system for nitrile glove sample

In the nitrile stress-strain curve, there are two outliers in the data making it seem as if the load is reduced when in reality the string pulling the load cell "lapses" around the motor shaft. This allows for a brief period of the string "slipping". This can be avoided by using a better clamping mechanism for the string and pulley system.

The same can be said for the Latex stress-strain curve. An outlier occurs due to the string catching onto the pulley mechanism. Our data is relatively unaffected as multiple trials enabled the outliers to not affect our results.

However, this system proved far more accurate and reliable than using a manual hand-pulley system (see Table 2). All of our goals were met in terms of accuracy, precision, reliability, and most importantly ease of use. This increases both safety and user morale when utilizing the system to its needs. Most certainly, this project proved the agile design method far superior to the "waterfall" method. In using the agile design process, more times than not the project fails to meet the specified budget and time constraints. This is especially common in the field of engineering and this project is no exception.