Measuring Polymer Strength using LabVIEW

by
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Category:
Prototype/Test

Products Used:
NI LabVIEW 8.2.1
NI GPIB Card
NI M Series DAQ Device

The Challenge:
Develop a software application to produce load barring stress onto a plastic polymer all the while reading multiple signals to determine the overall strength of the material**.**

The Solution:
Leveraging modular LabVIEW-based software architecture, Data Science Automation (DSA) has created a system utilizing National Instruments acquisition and communication boards to monitor and control signals containing loads, electrical stresses, temperatures and birefringence data.

Abstract:
A polymer manufacturer was at the mercy of an outside testing facility for determining the stresses that a new polymer compound could with stand. Using this outside test facility meant long and costly delays between the development and manufacturing of high quality plastic polymers. To replace the outside test facility, the effort would have to incorporate stress barring motion while acquiring and analyzing loads, temperatures, electrical conductivity along with birefringence data in a manor in which low values of polymers could be tested periodically during development.

Overview
Very few people give the manufacturing of plastic material a second thought that is until they purchase a new car or a new television and there is a material defect with their product. Also, if they hear that a new plastic polymer may have the ability to protect the very men and woman that provide freedom to this country. Recognizing the vital nature of their product a company decide to remove a bottleneck in there polymer product facility. Management understood the necessity to remove from the research and development system an outside testing facility that could and would create lost time that the manufacture could never recover.

Nuts and Bolts
The mechanical design of the project utilized a previously procured brushless servo motor used to stretch the polymer material in a uniformed and linear motion. By stretching the material vertical tensile stress will be applied to the material. This was measured by using a NI M-Series data acquisition device card to read signals from a load cell. Also as the material weakened in due the vertical stress the electrical capacity of the polymer would transform. To read this transformation the system integrated a Pico-ammeter which would read the electrical resistivity and transmit the data to the system via the GPIB bus. Most of the polymer material being tested would only stretch (without breaking immediately) only have reaching and maintaining a certain temperature. To read the temperature, the system integrated thermocouples which could be read also using the M-Series data acquisition device card.

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Configuring and Data-Logging
To configure a test run on a polymer, the test engineer would have interact with a simple and intuitive user interface (figure 1) for entering such values as stretching motion, hold time, stretch speed, electrical current settings, excepted load cell values, and many other test parameters. This user interface would ask the engineer individual questions in a manner that only acceptable values would be permitted minimizing the risk for destroying a resource without having valuable data to run analysis.

Once the test procedure has been configured, the system would then allow the engineer to see a sample or preview data set to validate all signals and instrumentation was functioning correctly. Also at this time the system would determine all offsets for birefringence reading and the acquisition rate during testing.

Motion and Temperature Control
The motion for stretching the polymer material was controlled using LabVIEW's ability to easily communicate with vendor supplied dynamically linked libraries, known as DLLs. The stretching motion was created by determine accelerations, decelerations and velocities along with distance and communicated these parameters to the motion controller using both vendor supplied and custom DLL function calls. The temperature control was handled using a simple onboard dial which the operator could manually control while reading real-time values from the user interface.

Analysis
After the completion of a successful test, all raw data acquired would automatically be analyzed (figure 2). Once the analysis was completed, the computational data would be placed within a common file hierarchy. This file hierarchy would allow the user to display multiple products tested or a particular product's cycle testing by using a simple mouse click. The analytical algorithms for determining stress capabilities where proprietary but constantly needed adjusted and validated. For this reason all raw data collected during a test had to accompany the analyzed data sets. This was also the case to ensure validation and quality assurance testing. To ensure quality assurance the system had to have the ability to reprocess all data collected, meaning the system had to (during testing) save test information along with the raw data so that all analytical data could, in the future, either be reprocessed or validated via an outside source.

The Bottom Line
To remove the unnecessary, costly and time consuming outside polymer tensile strength testing and verification system, a hardware and software product was created by Data Science Automation using National Instruments LabVIEW software and data acquisition cards. By using National Instruments products, Data Science Automation was able to create the solution in a timely fashion. And by creating the system using a modular software design, the customer had the flexibility to change and modify with relative ease any analytical algorithms to adjust to ever-changing polymer material. This solution meet the customers needs in the manner of removing the need for an outside source for testing while providing a reliable, repeatable and the ability to validate an in house solution.

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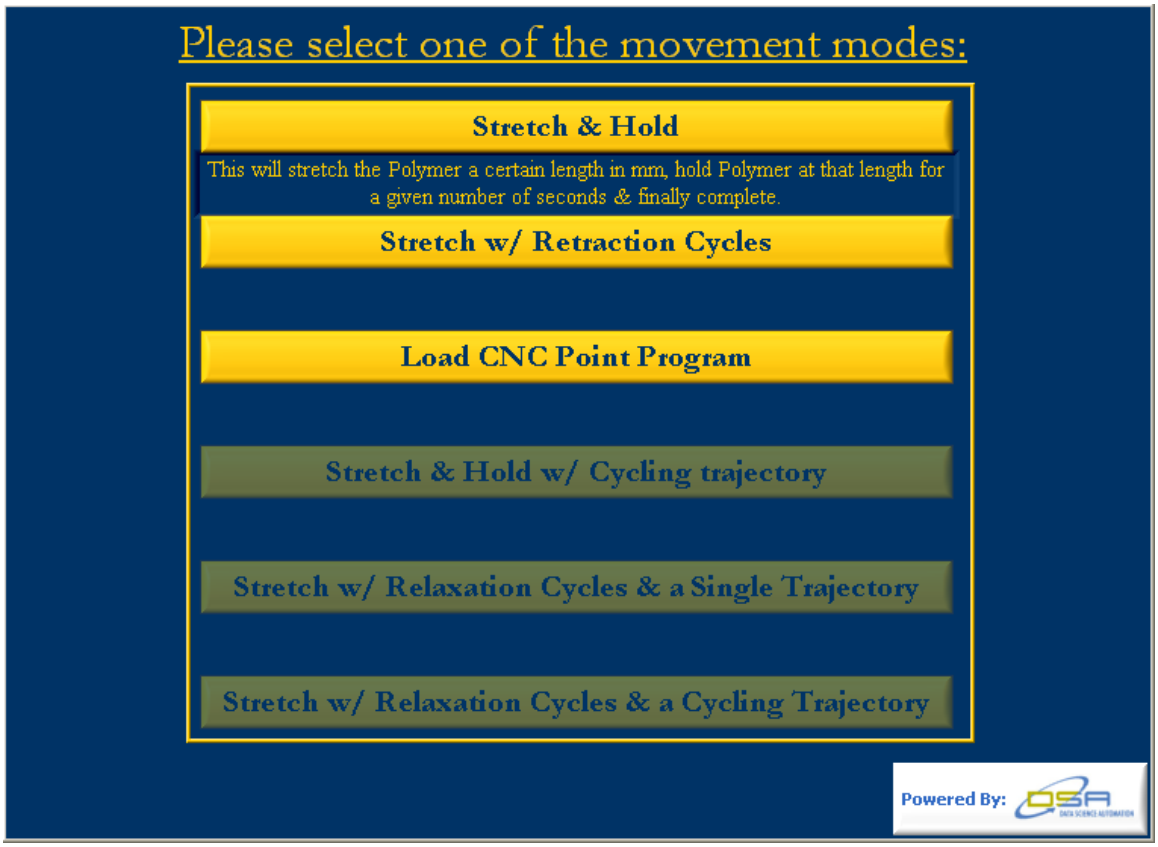

Figure 1 – Mouse clicks allow the user to efficiently select the current stretching parameters.

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Figure 2 - Analytical dsiplay for representing the current beifreingence calculations

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