



EFFECTIVE SOLUTIONS FOR CONTROL SYSTEMS AND AUTOMATED TEST EQUIPMENT

Automated Vibration Analysis of Automotive Research Mirrors

Category:
Automotive

Products Used:
LabVIEW™ Software
IMAQ™ 1408 card
IMAQ™ Advanced Vision Toolkit

The Challenge: Efficiently measure the vibration of a rearview mirror over a range of frequencies and process the resulting data to produce a report.

The Solution: We used National Instruments' LabVIEW™ software and IMAQ™ software and hardware to interface with the vibration table controller, measure the vibration, and produce the necessary reports.

Abstract

Britax needed to measure the vibration of automotive rearview mirrors over a range of frequencies and process the resulting data to produce the necessary reports for quality control and research purposes. The existing system was slow, had questionable accuracy and repeatability, and was difficult to use.

In this system, the reflection of an LED in the rearview mirror is captured via a video camera as the mirror vibrates. The LabVIEW™ based program communicates with the control software for the vibration table, stepping it through a user selected range of frequencies, collecting data during each test, and running the appropriate analysis on it.

Introduction

Britax needed to measure the vibration of automotive rearview mirrors over a range of frequencies and process the resulting data to produce the necessary reports for quality control and research purposes. The existing system was slow, had questionable accuracy and repeatability, and was difficult to use. The replacement system needed to be fast, accurate, and easy to use.

Existing System

The existing system reflected a laser off a vibrating mirror and onto a target, capturing the image displayed on the target. This system was difficult to calibrate due to the low quality of the image on the target. The reflection of the laser beam created a poorly shaped blob, reducing the accuracy of the system. Data was manually imported into a spreadsheet for processing, which was time consuming. Repeatability from test to test was low; testing was also a slow, multi-step process.

New System

The new system has a screen with an LED in the center, whose image is reflected in the rearview mirror. The reflection of the LED in the mirror is captured in Figure 1. The LED creates a

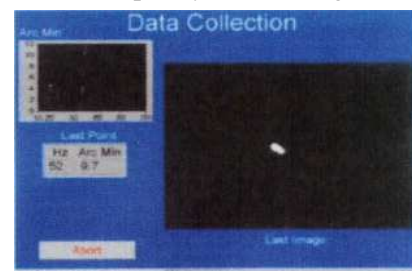


Figure 1: Video image of LED



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crisp round dot with high contrast to the dark background. The LabVIEW™ software based program communicates with the control software for the vibration table, stepping it through a user selected range of frequencies. In order to measure the amplitude of the vibration, IMAQ™ Vision algorithms are used to threshold the image and measure the maximum dimension of the line traced by the LED, which is converted to an angular displacement. Several measurements, at each frequency, are averaged to maximize repeatability. Once the test is completed, the results are analyzed and recorded to disk. The operator then has the option of printing the results in tabular or graphical formats.

Design Challenges

The image being measured needed to have high contrast with crisp, distinct borders in order to provide and accurate measurement. A super bright LED was mounted in the center of a black screen to meet this requirement. Figure 2 shows the reflection of the LED in the rearview mirror. A bright white dot with a



Figure 2: LED reflections

dark black background was obtained when this LED was viewed using the IMAQ™ image acquisition hardware. This image was easy to threshold, and varying the threshold level had only a slight effect on the size of the dot.

Accurate measurements also require an appropriate calibration procedure. For calibration, the LED in the center of the screen is turned off, and two calibration LEDs are turned on. The calibration process requires only two measurements. The first is the fixed distance, in millimeters, between the two LED lights on the LED screen to the mirror. This is the only measurement required from the operator, thus minimizing the possibility of human error. These measurements are then used to calculate the angular distance between the LEDs using simple trigonometry. Using the distance between the LEDs measured by the computer in pixels, a pixel to angle conversion factor is calculated

Several databases were created to make the user interface easy to use. These databases contained information such as part numbers, test types, etc. When preparing to test a new mirror, a set of pull-down menus is used to specify the mirror configuration. The inclusion of live IMAQ™ images as part of the screen displays makes positioning and calibration of the equipment easy, and the continuous display of results allows the operator to monitor the test procedure. Once the test is completed, the results are displayed on the user interface screen. The operator prints the desired reports, then returns to the test selection screen.

Results

The completed system resulted in high accuracy measurements with maximum repeatability of results. The easy to user interface and fast test cycle time helped the operators enjoy the testing process more, and they are able to complete their work in approximately half the time of the previous system. Britax is very happy with the performance of the system. They are currently using two of our systems, one in Michigan and one in England, and are considering purchasing additional systems for use both in the U.S. and overseas.