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APPLICATION NOTE:
Interfacing the Titan
Data Acquisition System
with MTS Road Simulation
Equipment

APN-1010

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SUMMARY

There are several situations when it is desirable to simulate actual road conditions in a lab for purposes of repeatable testing. The Titan™ Data Acquisition System manufactured by Mars Labs provides such a solution for this type of testing. The Titan can be used with equipment such as the MTS Road Simulator to provide a test sequence that is always repeatable. This eliminates potential problems with conventional test systems, such as human error while driving and waiting for ideal weather conditions. The major advantages of using this Titan/MTS system are that it offers a great deal of test integrity, measurement accuracy, and equipment commonality from road to rig.

EQUIPMENT REQUIRED

    Mars Labs: Titan Mini-Recorder Data Acquisition (DAQ) System
                   Titan DAC Analog Output module
                   Titan Control Software (TCS)
    MTS Systems Corporation Road Simulator

DATA COLLECTION

The process starts out with data collection at a proving ground test track or other locations that need to be simulated. Specific road inputs are collected for component evaluation on a vehicle. Once the vehicle gets scheduled with the Road Load Data Acquisition group (RLDA) a Titan Mini-Recorder installed in the vehicle. This group also installs acceleration, vibration, displacement, and load sensors throughout the vehicle, as well as wheel force transducers if applicable. The transducers are interfaced with the Titan in order to allow recording of the signals. The Titan Mini-Recorder supports a wide range of commonly used analog sensors for simulation such as strain gauges, accelerometers and load cells. The Titan Mini-Recorder also interfaces directly to Kistler and Michigan Scientific wheel force transducers. The Titan DAC Analog Output module is used to close the outer loop of your simulator when doing simulation. When collecting the test track data it is recommended to set the sample rate of the data acquisition system the same sample rate as your wheel force transducer. Common sample rates are 409.6 and 512 samples per second.

DATA ANALYSIS AND CREATING THE DRIVE FILE

Once the road segments have been acquired at the proving grounds, an RLDA engineer analyzes the TCS data to verify its integrity. If the data does not pass the verification process then new data must be collected. After the raw TCS data is verified the engineer exports the data into MTS-RPC format using the TCS software so that it can be used with the MTS equipment. This RPC format road data is then transferred to the lab test engineer where it is reviewed again. If necessary the engineer can edit the data to isolate pertinent information and patterns for testing. This process is called creating the drive file for RPC, which is what will be played back through the MTS 498 controller. The drive file is created using white noise frequency sweeps of 0 to 60 Hz, which will simulate typical road data inputs.

LABORATORY SETUP

Once the instrumented vehicle and Titan equipment are in the lab, the Titan Mini-Recorder modules are connected to the Titan DAC Analog Output modules to allow the use of analog outputs. Accelerometers are placed on the vehicle along the axes of interest and interfaced to the Titan Mini-Recorder modules. *Note that at this point in the testing it is important to set the sample rate to 1200 samples per second in the test.* By doing this it provides the highest quality analog output by over-sampling. The test rig is then put into operation using the known white noise frequency sweep and a comparison of the data is done using displacement versus acceleration graphs to obtain a frequency response curve. This curve will be used to create the drive file that matches the road data that was originally collected.

Once the drive file is completed, the original instrumented vehicle will be placed on the test rig with the Titan Mini-Recorder modules. The inputs are interfaced to the transducers on the vehicle and the analog outputs from the Titan DAC module are interfaced to the MTS 498 controller to be used as feedback signals. A copy of the original TCS road test used for the acquisition portion is created with some minor changes:

1) For wheel force transducers typically provide analog outputs. These are directly interfaced to the MTS system.

2) The Titan Data Acquisition System is set for 1200 samples per second

3) Since the wheel force transducer and the Titan Data Acquisition System both introduce time delays or skew it is important to enter this value into your controller software so the skew can be corrected for. Delay times are referenced at the end of this document.

Items 2 & 3 are minor changes done within the TCS software under the Device Configuration and Export screens. All other test parameters such as sample rates, anti-aliasing filter settings, input module addressing, gain settings, calibration and balance patterns are exactly the same as the original road test.

ROAD SIMULATION TESTING

The final phase of testing is the iteration process, which requires that the Titan and the MTS 498 controller to work together. The drive file created from the original data is used on the MTS equipment to control the inputs to the test platform. The Titan is used to monitor the accelerometers in the vehicle and that data is played out the Titan DAC Analog Output channels to the MTS 498 controller. The MTS B-TREN or BTH-MON program is now introduced for trend monitoring of the data being collected. The response signal from the Mini-Recorder module versus the desired response signal can be monitored with a percent deviation. This allows the test rig to automatically shut down if problems occur. The final results provide the engineer with the ability to inspect the components of interest for fatigue and failure.

APPLICATIONS

Several Mars Labs customers have found this testing process to be very beneficial since it eliminates many common problems. Using previously collected data allows for very accurate and repeatable tests as opposed to testing several vehicles by driving over the same track. Variables such as weather conditions, changing road surfaces, and human error are removed from the test which increases the accuracy of the data collected.

ADDITIONAL RESOURCES

Refer to Mars Labs application note *APN-1001 - DAC Analog I/O Applications*

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