imc

An Axiometrix Solutions Brand

Time-Saving Endurance Testing

Mobile and automated acquisition and analysis of vehicle vibrations

imc Test & Measurement
Application Note

APPLICATION NOTE

Introduction

Israel's geographic diversity includes coastal areas, deserts, and hilly terrain, which make up over half of the country. This varied landscape subjects off-road vehicles to unique challenges. MotionTech Ltd., an Israeli partner of imc, has created a mobile app using the imc CRONOS*flex* system and imc STUDIO. This application is designed to assess vehicle durability by measuring vibrations. The testing process is mostly automated, enhancing efficiency through integrated real-time data analysis. This feature streamlines the process by filtering and processing data as it's collected.

Automation increases test efficiency

Vehicle endurance tests, conducted under real-life conditions, provide information about the stress on vehicle components. For this purpose, the vehicle has to be driven at a constant speed on uneven ground for 10 seconds in order to obtain a random profile of the terrain during the measurement. The problem is that the quality of the recorded data could not be determined until after the test, so if a test failed, it could not be repeated until after the data had been analyzed. A lengthy stationary post-processing of the data analysis also delayed the development progress.

The primary application goal of imc's Israeli partner MotionTech Ltd. was to improve and simplify the test procedures and test environment. In particular, the time required for the endurance test was to be reduced without sacrificing test accuracy. This was achieved by the use of the modular data acquisition system imc CRONOS*flex* with the integrated real-time analysis tool imc Online FAMOS and a tablet PC based on MS Windows with imc Inline FAMOS.

This mobile data acquisition is started by the driver of the test vehicle via a customized application in imc STUDIO using a tablet and runs automatically. The recorded data is analyzed and validated in real time. In this way, the driver knows already during the test if there are enough valid data or if the test has to be repeated.

FIGURE 1.
Tablet PC positioned in the vehicle
©MotionTech

Test system overview

The automated test solution is comprised of the multichannel data acquisition system imc CRONOS*flex* (CRFX) and imc Online FAMOS, which provides integrated real-time data analysis als well as different sensors. On the software side, MotionTech, Inc. used the test and measurement software imc STUDIO for building and running the automated test application and the signal analysis software imc FAMOS. For displaying signals to the driver a tablet PC with MS Windows was installed in the vehicle's cabin.

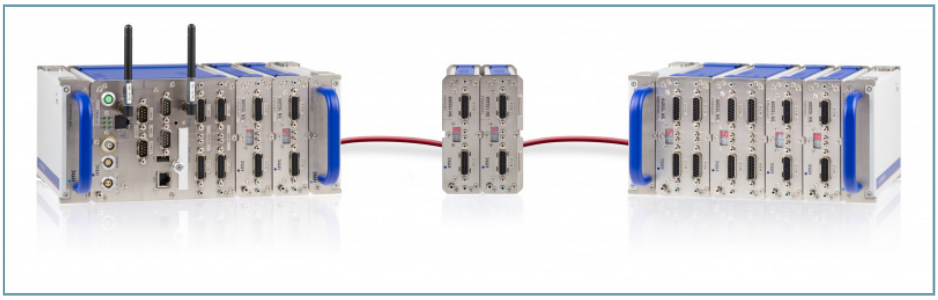

FIGURE 2.
imc CRONOSflex DAQ system

Automated Data Acquisition Solution

The uniqueness of this durability test is that it is not performed by strain gauge measurement, but by vibration measurement of selected (load bearing) vehicle components. It takes only 10 seconds of coherent data on a similar surface to determine the load on the component from a vibration profile. The test is repeated for a number of speeds and on a variety of surfaces, e.g. asphalt, gravel, sand.

Before starting to measure, the driver enters the environmental variables of the test on the tablet. The software used is a custom-developed imc STUDIO application with a graphical user interface. The required environmental parameters include the terrain, the speed at which the vehicle is to be measured and a measuring tolerance for the speed.

Until now, there was no way to set the terrain in the measurement software. Therefore, individual test drives had to be performed for each terrain. The ability to select a terrain in the software reduces the number of test vehicles and drivers.

Once the vehicle has maintained a constant speed for at least 5 seconds, data acquisition begins automatically. It is now necessary for the speed to remain constant for 10 seconds. For this purpose, the progress during this period is shown to the driver on the tablet in the interior of the vehicle.

Test Data Validation

The measurement data is automatically verified by the imc system in real time. If the deviations from the target speed during the measurement are too large, the system sends a signal via the display to repeat the test run. This is a significant advantage over the previous measurement method, where deviations could only be detected during post-processing of the data. The integrated real-time data analysis in imc Online FAMOS also automatically checks whether the recorded data makes mechanical sense, i.e. whether all sensors are correctly attached or whether there are any problems with the cables or if any problems occurred during the test.
An RMS (Root Mean Square) calculation is used to check whether the vibrations have a stationary origin.

The imc imc CRONOS*flex* DAQ system

The imc CRONOS*flex* DAQ system is used for the acquisition of various measurement data. Its modular design allows spatially distributed measurements. The basic module of the DAQ system can be extended with different modules thanks to its click mechanism. The location of the individual modules and the number of measurement channels are therefore scalable and almost unlimited.
In addition to the imc FAMOS signal analysis software installed on the tablet PC, the imc CRONOS*flex* also integrates the imc Online FAMOS for real-time data analysis. One of the function of the Online FAMOS algorithm is the automated adjustment of the number of channels required during the test.

Processing Real-Time Data with imc Online FAMOS and imc FAMOS

As described above, the integrated real-time data analysis functions of imc Online FAMOS are used to verify the quality of the recorded vibrations already during the fatigue test. The calculation functions of imc Online FAMOS can be executed in a time-synchronous, deterministic and cross-channel manner. For example, if the vehicle is driven at a constant speed for at least five seconds, the data acquisition starts automatically. During measurement, imc Online FAMOS monitors each measuring channel and checks every second whether the collected data are usable. In this way, imc Online FAMOS saves time and money, because subsequent evaluation is either not necessary or is considerably shortened.

FIGURE 3.
Tablet with imc STUDIO application in the vehicle ©MotionTech

GUI and data visualization

The imc STUDIO application shows the driver the progress of the test directly on the tablet. The usable data is processed by imc Inline FAMOS and visualized as a bar chart. This makes it easy to see how much usable data still needs to be collected. imc STUDIO is also used for the graphical presentation of data within a report.

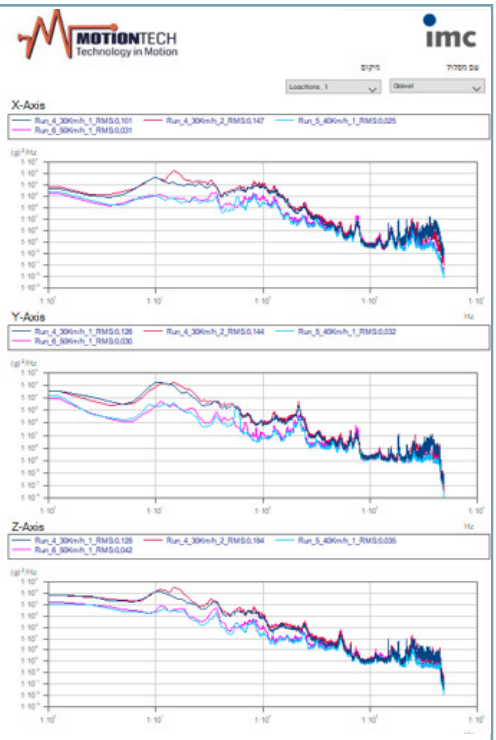

FIGURE 4.
Report generated out of the imc STUDIO application

Conclusion

There are many productive benefits to the solution developed by MotionTech Ltd. For example, time is saved and unnecessary test drives are avoided by using real-time monitoring and data analysis together with a graphical user interface.

The ability to select test conditions in the software also reduces the number of vehicles needed. With the imc system, the test vehicle is no longer tied to one type of terrain. Instead, it can perform test drives on a variety of locations. The final data report is also generated directly. This allows the measurement to be evaluated in real time.