CASE STUDY

Sound & Vibration Technology Ltd.
Strategic Partner

Automotive
PULSE Reflex, PULSE LAN-XI

Sound & Vibration Technology Ltd. (SVT), located on Millbrook Proving Ground in Bedfordshire, UK, is a provider of sound and vibration test-based solutions. Its relationship with Brüel & Kjær goes back to 2003. Recently, Brüel & Kjær cooperated on a test-services project that involved making measurements on a prototype Triumph motorcycle. The purpose of the measurements was to characterise certain operating vibration levels for subsequent component durability testing. Brüel & Kjær's PULSE LAN-XI was used to collect all the measurement data that was then post-processed using PULSE Reflex Core.

Front page photo courtesy of Triumph, all other photos courtesy of Sound & Vibration Technology Ltd.

Brüel & Kjær

About Sound & Vibration Technology Ltd.

Sound & Vibration Technology Ltd. (SVT), located on Millbrook Proving Ground in Bedfordshire, UK, is a provider of sound and vibration test-based consulting. For more than 30 years, SVT has specialised in providing solutions for a wide range of engineering problems through application of advanced noise and vibration testing methods and analysis. SVT provides leading edge, integrated services to automotive, aerospace, rail and industrial clients in Europe, the Far East and the US. These services include:

- Consultancy & Troubleshooting
- Automotive NVH Programme Support
- Technology Development
- Training & Technology Transfer
- NVH Simulator
- Software & Systems

Fig. 1
SVT Director, Richard Johnson

SVT was formed in 1995 through the purchase of the UK NVH operation from MSX International. Prior to 1995, the group formed the core of the SDRC Engineering Services division, based in Hitchin. In 1999, the company moved to the Millbrook Proving Ground and today the company has a total of seven employees. These include NVH engineers, technical specialists and support staff with SVT Director, Richard Johnson, dealing with the commercial aspects of the company.

SVT's main focus markets are automotive OEMs, suppliers and aerospace companies and its goal is to help clients achieve the right sound and vibration characteristics for their products in the most effective way.

SVT envisions its future growth to involve more strategic partnerships with test organisations, software and design companies. Looking at vehicles of the future, SVT is already involved in Hybrid Electrical Vehicle (HEV) and Electrical Vehicle (EV) development as well as working with prestigious customers such as Bentley, Jaguar-Land Rover, Triumph, Honda, Tata Motors, Nissan, Aston Martin and Ferrari.

Successful Cooperation

The SVT/Brüel & Kjær relationship goes back to 2003, and has many facets including:

- Research work on behalf of Brüel & Kjær for its clients
- Sales and technical support for Brüel & Kjær's Test for I-deas software
- Assisting with advanced, internal, NVH projects – Source Path Contribution (SPC) process development
- Major partner in development of the NVH Simulator
- Being a testing partner in the UK

Fig. 2
SVT's facility on Millbrook Proving Ground, Bedfordshire, UK

SVT's location on Millbrook Proving Ground provides direct access to a complete range of track and chamber facilities. Indoor facilities include multichannel noise and vibration data acquisition and analysis capability using a full suite of Brüel & Kjær software including PULSE LabShop, PULSE Reflex and Test for I-deas. Brüel & Kjær front-ends (1 × 64-channel and 2 × 17-channel) and transducers are used almost exclusively. Other Brüel & Kjær products at SVT include a sound intensity probe, and Automotive Sound Quality software.

SVT's facilities include a hemi-anechoic chamber that was built in 2000, which has a background noise level of 20 dB(A) and a cut-off frequency of 200 Hz. SVT also has the use of a hemi-anechoic test engine cell that includes a Two-wheel Drive Rolling Road Chassis Dyno. As a major partner in the development of the NVH Simulator, SVT has both an in-house Full-vehicle NVH Simulator (based on a Honda Accord) and a Desktop NVH Simulator. The

NVH Simulator accurately recreates the noise and vibration of a vehicle in a user-interactive environment and enables the user to evaluate NVH problems in vehicles which haven't yet been built.

SVT Characterise Operating Vibration Levels on a Triumph Motorcycle

A recent example of a SVT test-services project involved making measurements on a prototype Triumph motorcycle. The purpose of the measurements was to characterise certain operating vibration levels for subsequent component durability testing.

With Brüel & Kjær's 12-channel LAN-XI Front-end Type 3053-B-120, Battery Module Type 2831, LAN-XI Notar™ BZ-7848-A (firmware that allows a LAN-XI module to be used as a stand-alone recorder) and Miniature Triaxial DeltaTron® Accelerometers Type 4524-B-001, measurements were made at three locations on the motorcycle:

1. The headstock or steering head
2. The instrument pack
3. The switch cube

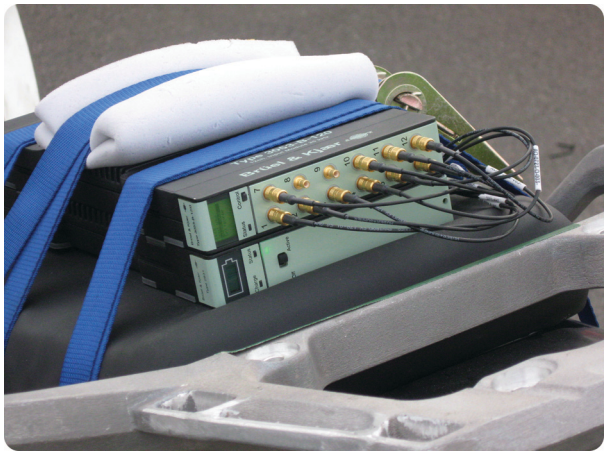
The headstock was used as a standard reference vibration location. The measurements were made at the instrument pack and switch cube in order to provide data for the generation of accelerated life cycle durability tests. An electronic pulsetrain from the motorcycle crank sensor was used to provide an engine tachometer signal.

Miniature Triaxial Accelerometer Type 4524-B-001 mounted on the switch cube

Measurements of operating vibration were made in three different environments – smooth track, pavé (Belgian pavement) and rolling road motorcycle chassis dynamometer. The smooth track and pavé measurements were made at MIRA's proving ground (No. 1 circuit and Pavé) in Warwickshire.

LAN-XI Collects Data in All Conditions

In order to collect data for the dynamometer tests, the 12-channel LAN-XI Front-end was networked to a laptop running PULSE Time Data Recorder Type 7708 so that the data collection and engine tachometer could be monitored in real-time.



LAN-XI installed on rear seat

With driving conditions for the track tests consisting of wide open throttle, constant speeds and slow acceleration measurements on both smooth track and pavé, a small and rugged system was required. Enter LAN-XI Notar. Expanding on the LAN-XI platform, LAN-XI Notar allows you to record time data to an internal memory card transforming the LAN-XI module into an entire measurement system, a very small and rugged data recorder. It can be used where no PC-based recorder could survive as the solid state memory card has no shock-sensitive moving parts, unlike tape recorders or PC hard drives. This means that the LAN-XI front-end and battery module could be strapped to the rear seat of the motorcycle. Previous front-end hardware used by SVT had not been sufficiently robust to mount in this way and would have been mounted in a backpack – with all the difficulties associated with cabling and restriction and safety for the rider. LAN-XI, however, suffered no ill effects or data discontinuities even when driven over the pavé circuit at 40 mph (64 km/h) – which is an extremely violent test.

The data collection parameters were loaded to the front-end via a LAN connection prior to running the tests in stand-alone mode. The data collection was then carried over a number of sequential tests by a simple

push-on push-off acquisition sequence. The simplicity of this data acquisition process enabled it to be performed by the motorcycle rider who had no prior test instrumentation experience.

For post-processing of data, SVT chose to use Brüel & Kjær's PULSE Reflex Core – a natural choice as SVT was not only a beta tester but had also been closely involved with the development of PULSE Reflex over a period of three years.

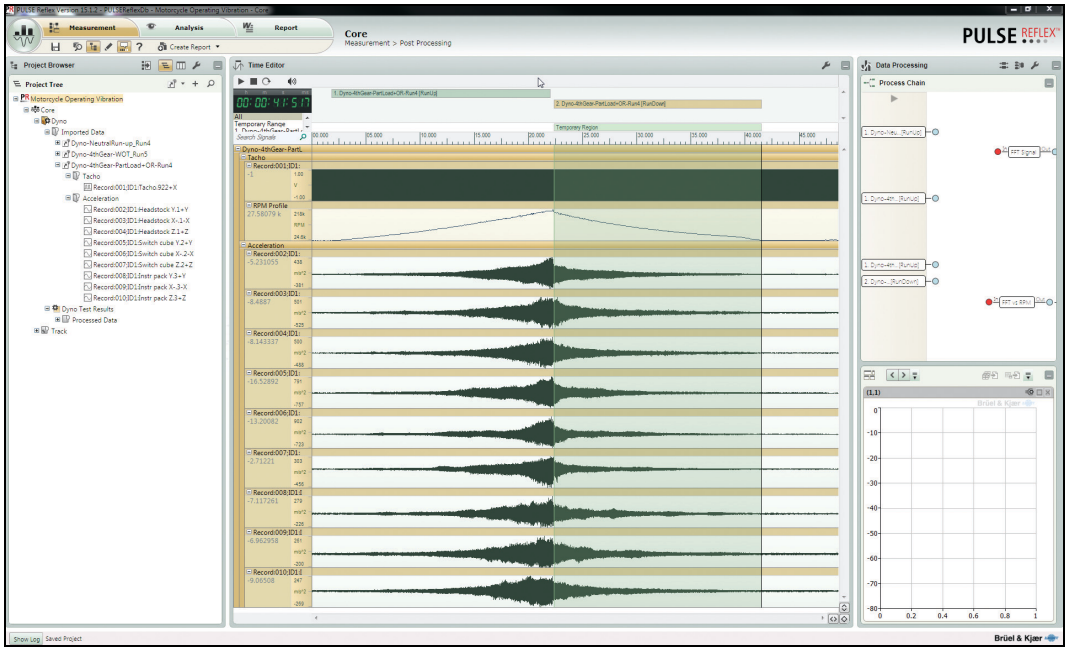
Richard Johnson says, "LAN-XI was perfect for this test as we couldn't have a laptop and a large front-end. We had to have a small compact system that could not only collect vibration data but also record the tacho signal. Our goal was to verify the level of vibration which would enable Triumph to set targets for its suppliers". He continues, "Using TEDS transducers and having the benefit of Dyn-X, the total setup time was less than one hour and the system was calibrated prior to testing".

The measurement results and analysis were recorded in a technical report, which was then sent to Triumph for subsequent technical evaluation.

Post-processing Data with PULSE Reflex – How it's Done

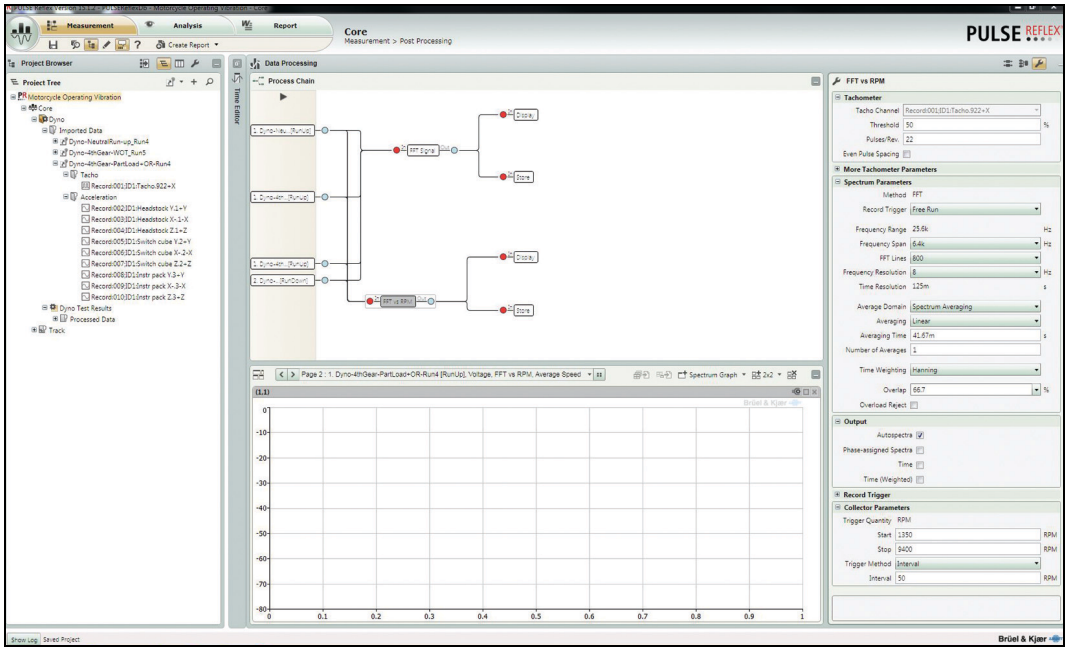
PULSE Reflex is ideal for the processing of the type of data gathered during this project, where multiple channels of data are collected for multiple test cases, each requiring several different formats of processed results. The data processing using Reflex proceeds from left to right on each screen in an intuitive manner. Here's how it works:

1. Data Selection: The original raw data (PTI format) is linked to Reflex using the project browser window. Each time file can then be dropped into the Time Editor window where an RPM time curve is automatically calculated. It is then a simple matter to select the required rpm range and create a region (as indicated in the top portion of the Time Editor window). The regions are then dragged into the left hand portion of the data processing window. The whole process is quick and intuitive.

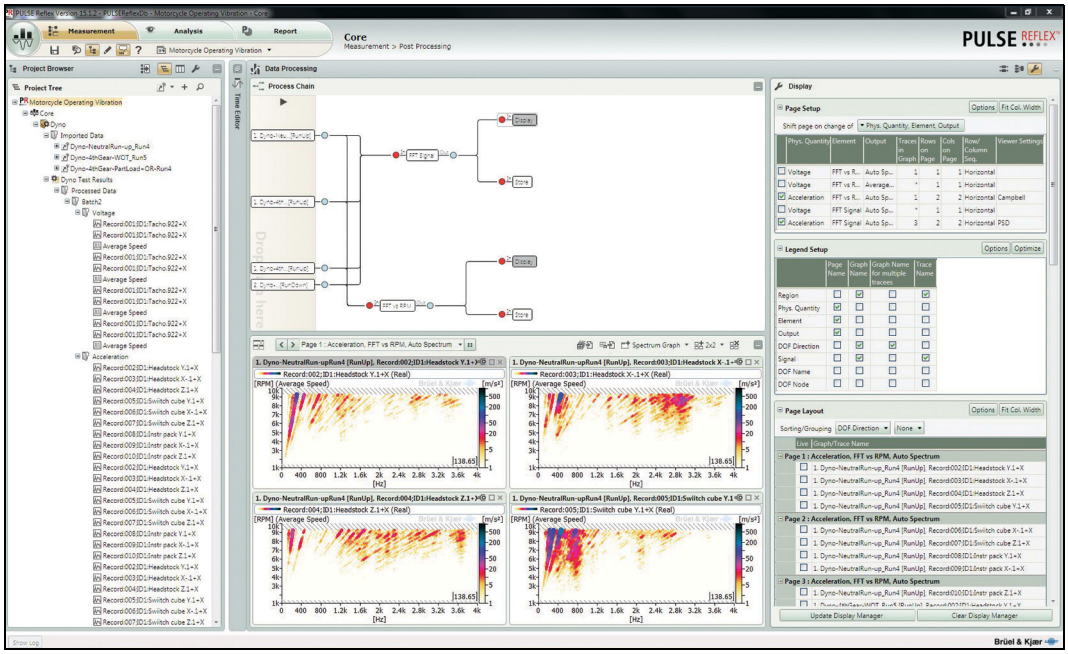


2. Data Processing: A process chain is created by dropping elements from a choice of 21 possibilities (including FFT narrowband and octave analysis, slicing, filters, etc.). Process chains enable a number of these elements to be connected to a time history region (or several regions) either in series or parallel. The whole chain may then be batch processed in one operation. Process chains can be saved for import

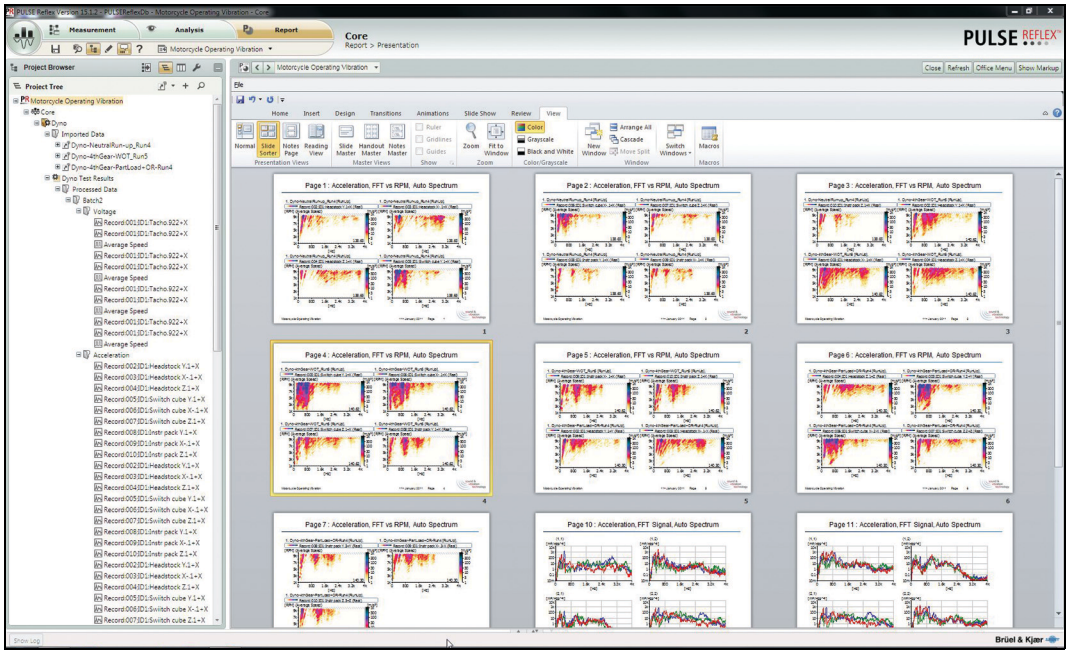
into future projects where the same processing parameters are required – ensuring that comparable data can be collected time after time.



3. Data Output: The display setting window allows the user to prepare the output in certain desired grouped formats. In this case, Campbell diagrams, one per channel, were plotted four to a page. Equivalent peak hold spectra were grouped in threes per graph and four graphs per page according to the accelerometer locations and test condition. The generation of such plots for large datasets can be extremely time consuming and can often result in mislabelling of data. PULSE Reflex dramatically reduces the time required for this process and avoids any mistaken labelling by automating the process.



4. Reporting: Once the displays have been configured, a single selection will export all of this data to a pre-formatted report template, with the associated labels for each page and graph. This feature offers another significant time saving over manual methods.



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