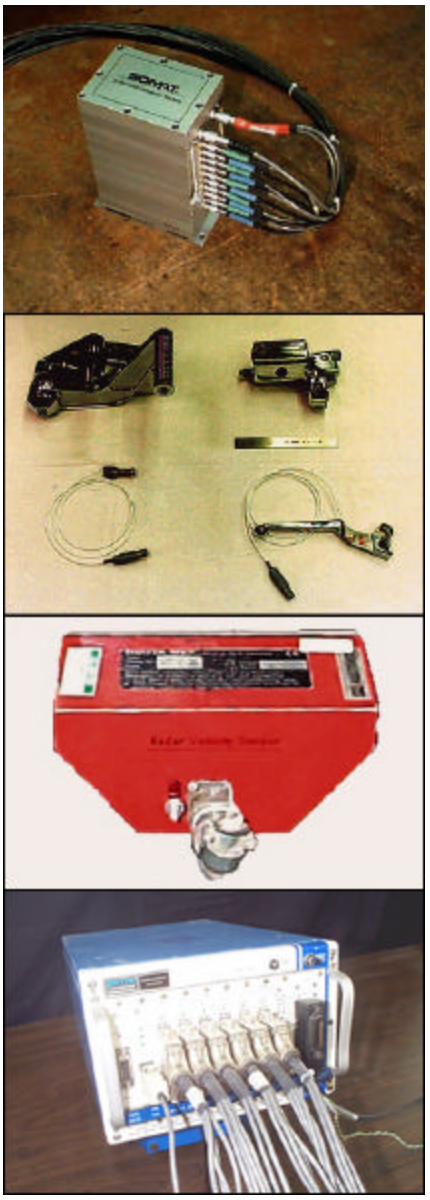
Data Acquisition & Analysis

NATC's extensive data acquisition and analysis capability is vital to the test and evaluation process. NATC develops information to reach the overall objective; providing real-world solutions.

Data Acquisition Options



NATC uses a wide variety of transducers to measure performance parameters for vehicles of all types. Examples include mechanical, optical, electrical, or magnetic sensors such as accelerometers, strain gages, and thermocouples. Outputs are recorded on analog or digital microprocessor controlled recorders. Since multiple techniques and equipment types are available for most measurements, the methods and equipment chosen will vary to meet the needs of the customer. For data acquisition, NATC utilizes systems such as the Optim-based Megadac, Somat and the NATC built Solid State Vehicle Recorder (SSVR).

The Optim-based Megadac system can be used to record over 150 channels of data simultaneously. It can operate at from 1Hz to 250 kHz sampling rates. The Megadac is a robust system that can be used in a wide variety of environments from cold (-50°F) to hot (+175°F). It has built in signal conditioners which can accommodate any type of sensor. The Megadac comes with TCS software which allows data to be checked in the field for efficient test conduct.

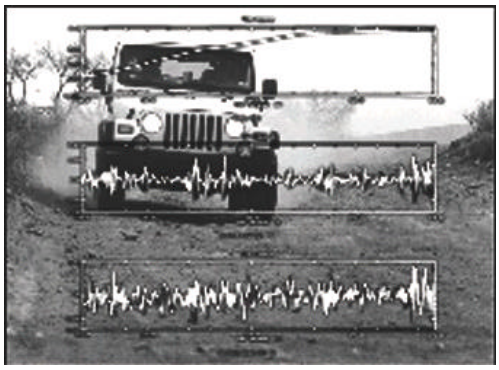
The Somat data acquisition system is very compact. It is useful for jobs requiring a smaller number of data channels. It has the capability of performing time and frequency domain data analysis in the field using Somat Ease. The data can be acquired in a rainflow format to perform life prediction analysis.

NATC developed the SSVR-I data acquisition system specifically to support durability projects where versatility, space requirements, minimum weight and robustness are of primary concern. The SSVR-I can record up to 8 analog inputs, plus vehicle speed and engine RPM. The SSVR-I has been used on vehicles ranging from motorcycles and passenger cars to commercial trucks and transit buses. Durability test vehicles at NATC utilize the SSVR-I as a method to monitor and quantify accelerated durability test cycles throughout the test program.

The SSVR-II was developed at NATC for expanded data acquisition and analysis of up to 256 channels. The sample rates for these systems range from 0.2 Hz to 5,000 Hz per channel. Removable media is used to store large data files and can be downloaded in the field.

Power systems, interface circuits and data acquisition systems have been developed specifically for motorcycles, cars and trucks of all types and sizes. Typical sensors include pulse pickups, strain gages, accelerometers, displacement transducers, load cells and thermocouples.

The recorders are ruggedized to survive the extremes of shock and vibration, dust, and temperature common to a testing environment. Calibration documentation for all instrumentation is in accordance with the requirements of MIL-STD-45662, and is maintained on file.



Typical data reduction and analysis operations

Time Domain Routines

1. Auto and cross correlation
2. Auto and cross covariance
3. Averaging (running average or n-point average)
4. Digital filtering
5. Curve fitting (linear, exponential and polynomial)
6. Integration/differentiation
7. Probability Density Function (PDF)
8. Principal strain and principal stress routines for strain gage data
9. Statistics of the data (Number of observations, maximum value, minimum value, range, mean, variance, and RMS value, t-tests, ANOVA, non-parametric tests)
10. Data manipulation (arithmetic operators such as adding, subtracting, multiplying and dividing all the values for the channel or adding, subtracting, multiplying and dividing channels together; mathematical operators such as sine, cosine, tangent, square root, exponent, log, minimum, maximum absolute value; resampling; interpolation and outlier rejection)
11. Histograms

Frequency Domain Routines

1. Fast Fourier Transforms (FFT) with different filtering techniques
2. Power (Auto) Spectral Density (PSD) -- g^2/Hz versus frequency
3. Transfer function
4. Transmissibility
5. Coherence
6. Cross spectra
7. Hilbert transforms
8. Ensemble averaging
9. Rainflow analysis for fatigue life predictions
10. Histograms

NATC Graphic Output Capabilities of the Reduced Data Include:

1. Variable plotted versus time
2. Variable plotted versus another variable
3. Variable plotted versus frequency
4. Variable plotted versus frequency and time (spectrogram) in either two-dimensional (contour) or three-dimensional layouts
5. Listings of the tabular data and calibration files

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