Transmission Dynamics

Inset: Installed on shaft

Quick Deployment Wind Turbine
Torque Monitoring Unit - Overview

BACKGROUND

Many long term installations, such as wind turbine or other renewable energy generators, or marine propulsion systems, can over time develop problems caused by excessive static or dynamic in-service loading. Retrofitting typical instrumentation to troubleshoot problems would often require expensive and time-consuming modifications.

JR Dynamics Ltd have designed an all-in-one quick-deployment package, which includes magnetic mounting clamps to fit to any shaft diameter (larger than 300 mm) and integral battery supply, allowing long-term unattended torque data collection. Installations can be as simple as clamping the instrument, and adhering one or two pre-wired gauges to the shaft with rapid setting epoxy.

DATA LOGGER

Microlog is a miniature instrument designed for long term unattended data logging. Microlog samples at rates of up to 4,000 Hz with 16-bit resolution, and can log and evaluate real time stresses and loads on two channels simultaneously.

Microlog is programmed for on-line evaluation of Rainflow distribution, a widely used statistical evaluation of fatigue life based on long-term monitoring.

Microlog, equipped with digital radio communication for programming and data downloading, has 2 MB of RAM and 256 kB of flash data memory for storing 200 highest events (time-domain samples), time at level and rainflow count data.

The control software is activated from a PC via the supplied USB Bluetooth transceiver. An external computer is only used to program Microlog and to download captured data for further post-processing. A live telemetry mode is also available for real-time data streaming. The range of communication between the Microlog and Transceiver is over 100 m in open space, allowing the user to download data from a wind turbine nacelle whilst at ground level.

Transmission Dynamics provide a range of our own telemetry instrumentation products, which are used by blue-chip technology clients across the globe. Our in-service unattended data loggers are currently in use in dozens of critical applications, including 5 MW+ wind turbine gearboxes, mining, marine, defence, automotive and rail applications.

GENERAL

Proper understanding of in-service loading is necessary for the design of cost effective mechanical structures and power transmission systems.

It is important that in-service data is acquired during operation covering full spectra of working conditions. Measurements should be carried out for long periods of time so that transmission loads can be recorded in a statistically significant way.

Ideally, in-service load measurement should be carried out for periods of 1…10 months on transmission systems with different operating profiles. Such protracted measurements - say typically 1000 hrs of continuous measurement - results in a vast amount of data which must be analysed and reduced to a simple data set for design and test purposes. A comprehensive software suit supplied with a standard Microlog allow on-line data analysis and data reduction.

INSTRUMENTATION

Microlog is a self-contained instrumentation and data analysis system comprising of:

- 2 channel strain gauge signal conditioning, accommodating full-, half- and quarter-bridge gauges or other transducers;
- 4 kHz low pass active filter on each channel (-120 dB roll off per decade);
- Independent signal offset, software gain (1 to 4X) and shunt calibration facility on each channel;
- 300X hardware gain (customisable from 1 to 1000) and 16-bit data sampling up to 4 kHz;
- Temperature and battery level monitoring;
- Comprehensive data handling and storage including:
  1. Rainflow Count (64x32) and Time at level.
  2. Short bursts of time domain data
  3. 100 highest events recorded in time domain, including accurate time stamp

Data is downloaded over a high-speed, robust Bluetooth pairing, giving a range of up to 100 m.

Live data streaming (telemetry) mode allows real-time streaming of both channels to a PC, or to 16-bit analogue voltage outputs on the USB telemetry transceiver to plug to any third party equipment.

DATA ANALYSIS

TIME AT LEVEL
Time at level analysis sums the total time (or the number of shaft revolutions), which is accumulated over the measurement period at each of the 64 load or torque levels. This results in a simple torque or load vs. time histogram.

RAINFLOW COUNTING
Rainflow analysis is often used when the structure is subjected to random loading. The analysis determines the total number of fatigue cycles which occur at 32 levels of mean and 64 levels of range (closed peak to peak fatigue cycles). The output is produced in the form of a 3D matrix defining number of closed fatigue cycles at specific mean vs. range locations.

TIME DOMAIN DATA CAPTURE
Microlog is capable of logging and accurately time stamping up to 100 highest events in the time domain per channel. Each event is captured with 30% pre-trigger information. The highest time domain events are stored on board the 2 MB RAM memory.
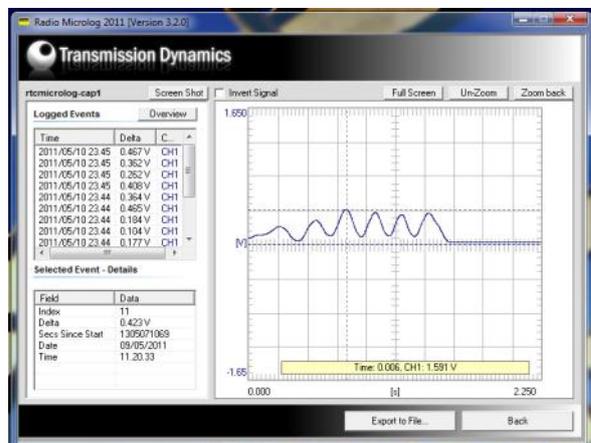

Figure 1: Time-domain event shown on client software

APPLICATIONS

- Load and stress monitoring of dynamically loaded systems and structures
- Endurance and fatigue life estimation of products and components.

More information, including a technical specification, is available from our website.