Gantner instruments

Application Solutions

CERTAINTY BY RECORDING AND MONITORING STATISTICS

Intelligent solutions
for structural monitoring

STRUCTURAL DIAGNOSIS AND STRUCTURAL MONITORING

Dam monitoring at Lüner Lake (Austria)

Long term as well as temporary monitoring of structures such as bridges, dams and buildings forms the basis for structural diagnosis as well as for structural supervision. The condition of the structure can be determined using various measured variables and, after definition of the criteria, evaluated and appropriate action taken. Classic examples here are permanent monitoring of expansion joints on a freeway bridge requiring renovation, or monitoring a dam for minimal changes in inclination.

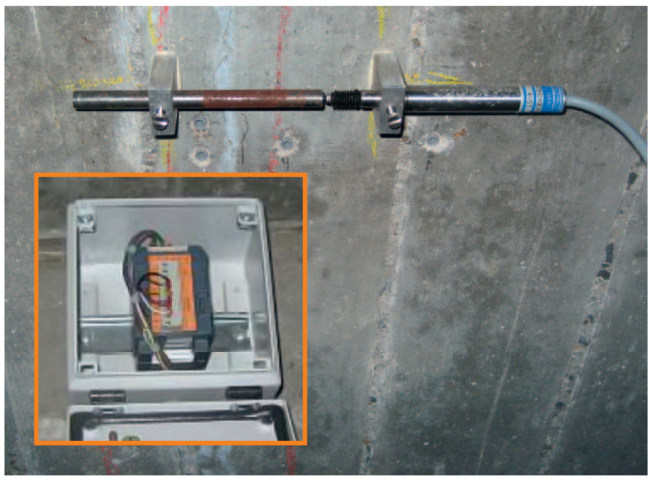
But even during the construction phase it may be necessary to monitor certain parameters. These include particularly temperatures (hydration) and expansion on concrete elements as well as displacement.

Another segment of structural diagnostics is temporary monitoring during work in the immediate vicinity of the structure. This includes work such as major earthwork or demolishing adjacent structures in the immediate vicinity.

As a matter of principle these include static parameters such as expansion values, loads, displacement values and temperature as well as dynamic variables such as vibration and concussion.

In the attempt to balance safety requirements and cost consciousness, monitoring structures and diagnosis of the structural condition is a proven means of simultaneously achieving cost efficiency and safety. Unfortunately there are repeated examples of severe damage, which could have been avoided by proper monitoring. This is particularly dramatic when human injury is involved.

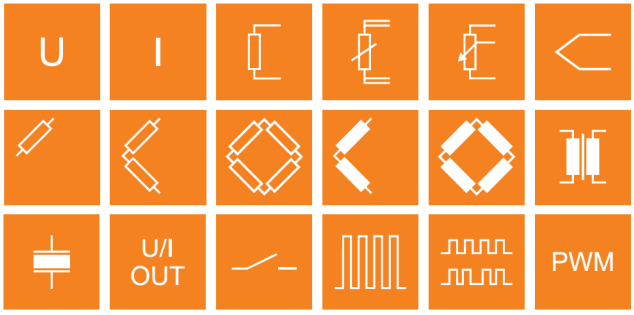
In addition to ruggedness, measuring systems for structural monitoring require that all relevant signals be captured quickly, locally, precisely in a stable manner, that they automatically perform more or less extensive data reduction operations (minimum, maximum, standard deviation, mean and limit) and store and visualize the measured as well as the calculated data as well as transferring it worldwide to a control point, e.g. via Internet.



Measuring the changes in crack widths on coupling joints between segments of a freeway bridge on the German A7 freeway. The signals from the inductive travel sensors at each coupling joint are captured by the e.bloxx A6 modules, conditioned and transferred to the control point via a serial RS485 bus.

REMOTE MEASURING POINTS

The size of the structure makes central capture of the measured signals virtually impossible. It is necessary to measure and digitize the signals at a short distance from the sensor and transfer them over a great distance to a central point using a sturdy field bus. In spite of the remote locations, synchronous capture of the measured data remains essential in order to correctly interpret multiple axis vibration on a bridge using correlating data.



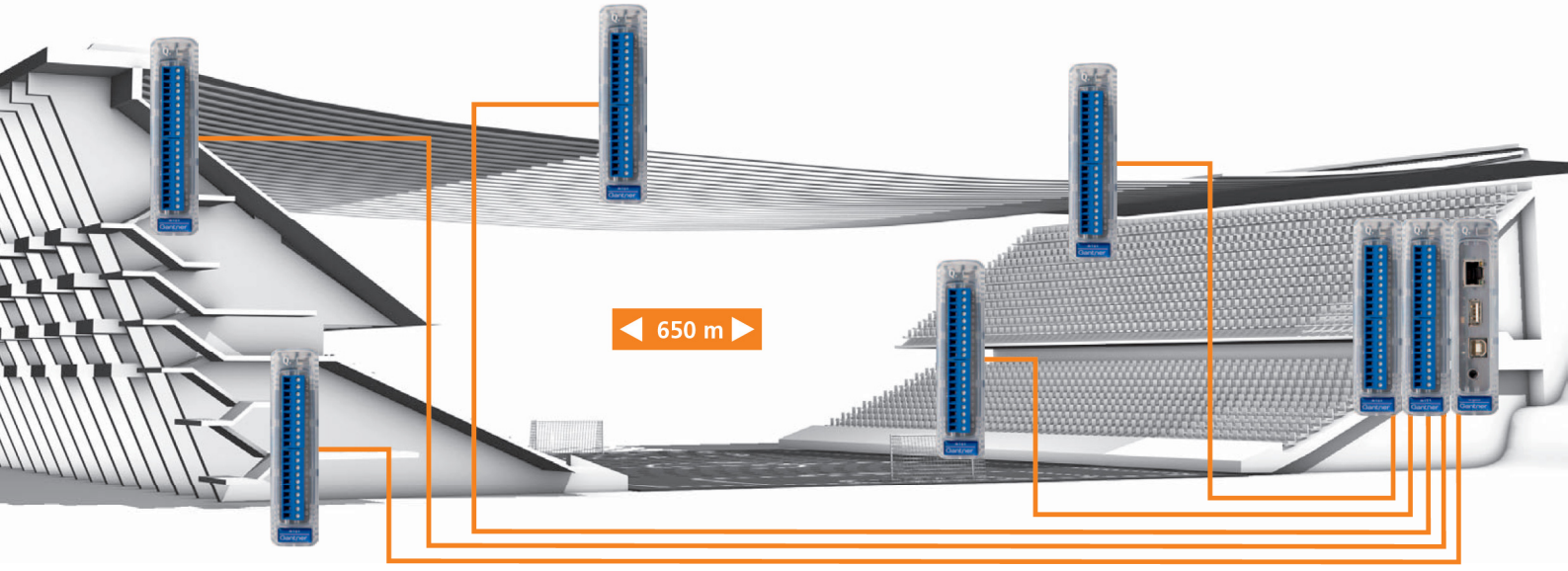
Capture of

- **meteorological parameters**
- **mechanical values**
- **position values**
- **electrical variables**
- **thermal values**

The remote modules capture all standard sensor signals with high accuracy, synchronously at measuring rates of up to 100 kHz and transfer the data to a controller via a serial RS485 interface.

The most important features of the measuring modules include:

- Galvanic isolation of all channels, power supply and interface
- 24 bit ADU resolution
- Measuring rate up to 100 kHz
- Intelligent signal conditioning
- Can be synchronized with test controller
- Serial interface, optional fiber optic conductor
- 10…30 VDC power supply



Continuous monitoring of European Cup Stadium in Braga, Portugal: Synchronous capture of over 100 signals from remote measuring points at a rate of 250 Hz. The vibration values for the suspended grandstands, forces in the steel cables between the grandstands and meteorological values are measured and evaluated.

TRANSFERRING AND ARCHIVING MEASURED DATA

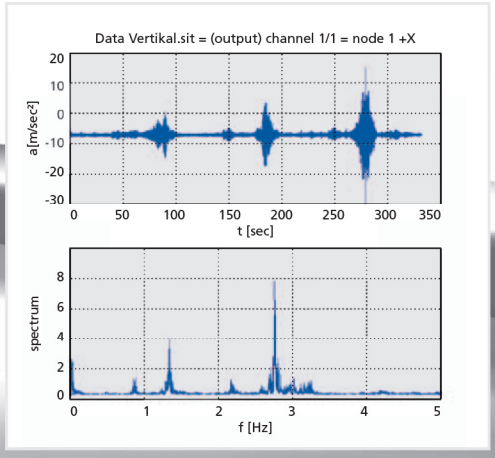
Transfer of measured data and evaluation results as well as alarm messages is a primary requirement for structural monitoring. The data reduction and alarm features make it possible to communicate with a supervisor in previously defined situations..

Communication possibilities

- Ethernet as FTP server or FTP client
- Modem via serial interface
- VPN via rooter
- Automatic Email notification with prepared texts and data attachments
- Access via Internet

Archiving data with test.node

If the monitoring system is incorporated in to a network and the data is to be stored in a local PC or in a database, the test.node server software is the right solution. The data is transferred or copied from the controller; statistic calculations are preformed, the data is converted to selected formats and saved in a directory on any server in the network. The data can be visualized using the test.viewer. test.node is in use, for example, for monitoring the Reichs Bridge in Vienna, the pump storage at the KOPS II power plant and in many wind power stations.

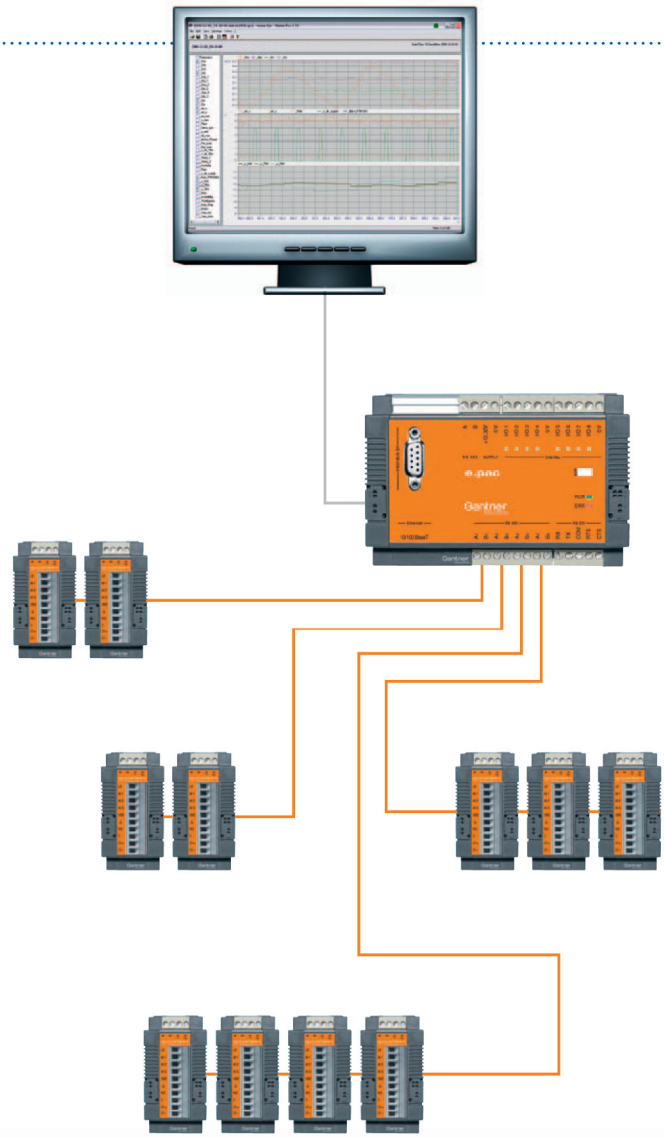


Synchronized capture of acceleration rates allows correlation of the measured data.

CAPTURE AT CONTROLLER LEVEL

Such remote setups allow the individual measuring modules, which may be up to several hundred meters away, to be connected to a test controller using four serial lines. This controller includes the following features:

- Synchronization of remote measuring modules
- Synchronization of a number of test controllers via internal or external signal (e.g. IRIG)
- Time stamp for each data package per cycle
- Data buffering for block transfer
- Measured data storage capacity approx. 30 million values, expandable with external USB memory
- Configuration as FTP server or FTP client
- Various interfaces and wide variety of communication possibilities
- Calculation, logical operations and control,
  - Memory organization for saving measured or calculated data
  - Calculation of statistical data such as minimum, maximum, mean and standard deviation
  - Monitoring of any type of data to ensure that limits are not exceeded, including alarm



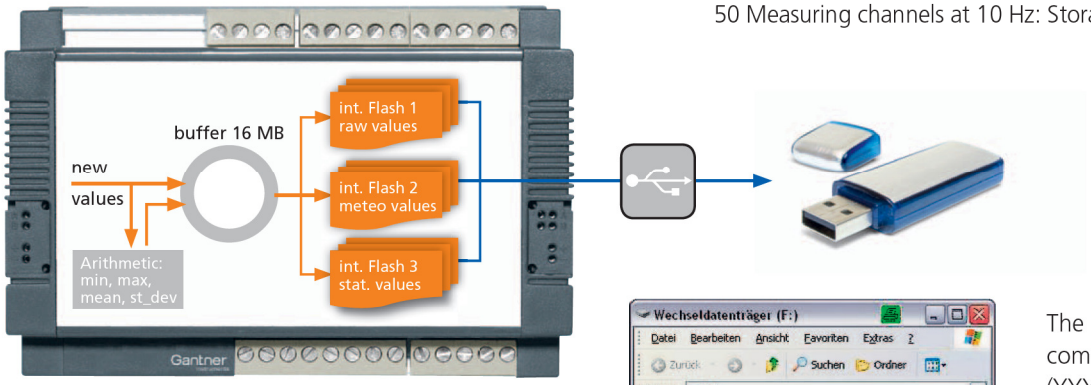
The 5 abutments of the Millau Viaduct are equipped with a remote measuring system, consisting of measuring modules and one e.pac test controller. The entire system is synchronized by a GPS signal, allowing processes such as vibration curves to be recorded for the entire bridge.

STORAGE OF MEASURED DATA IN SYSTEM

Structural monitoring does not always allow measured and calculated data to be saved on a PC. T he e.pac DL test controller has memory capacity for approx. 30 million measured values, and a USB interface allows virtually unlimited add-on capacity using common storage mediums. The memory can be subdivided in to a maximum of 4 partitions. Various types of data can be assigned to these partitions or the partitions can be configured with various measuring rates and triggering conditions. If a USB storage device is not available, the internal storage is used automatically; when a USB memory is plugged in, all data can be transferred or alternatively copied to this memory. This can be accomplished with or without access protection.

Kapazität des Datenspeichers

- Internal store approx. 30,000,000 values
  50 Measuring channels at 10 Hz: Storage time approx. 16 hours
- USB flash, e.g. 4 GBytes, approx 1,000,000,000 values
  50 Measuring channels at 10 Hz: Storage time approx. 23 days
- USB HDD, e.g. 200 GBytes, approx 50,000,000,000 values
  50 Measuring channels at 10 Hz: Storage time approx. 3 years



The data is stored in compact, binary format: (YYYY-MM-DD_hh-mm-ss) The data can be visualized with the test.viewer by clicking on a file name and can be saved in various formats (e.g. Excel, Famos, MatLab, Dasylab etc.).

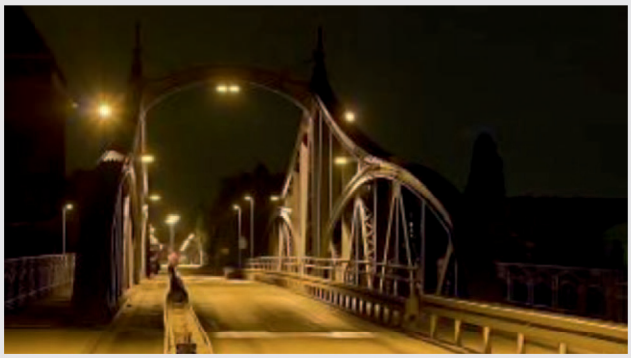
APPLICATION EXAMPLES

Stari Most, Mostar (BiH) Partner: LGA Bautechnik

Millau Viaduct (F) Partner: Sites S.A.

Conveyor Bridge, Senftenberg (D) Partner: LGA Bautechnik

Köhlbrand Bridge, Hamburg (D) Partner: LGA Bautechnik



Turning Bridge, Krefeld (D) Partner: LGA Bautechnik

Cloister Church, Speinshart (D) Partner: LGA Bautechnik

Lüner Lake (A) Partner: Vorarlberger Illwerke

European Cup Stadium, Braga (P) Partner: Interfels

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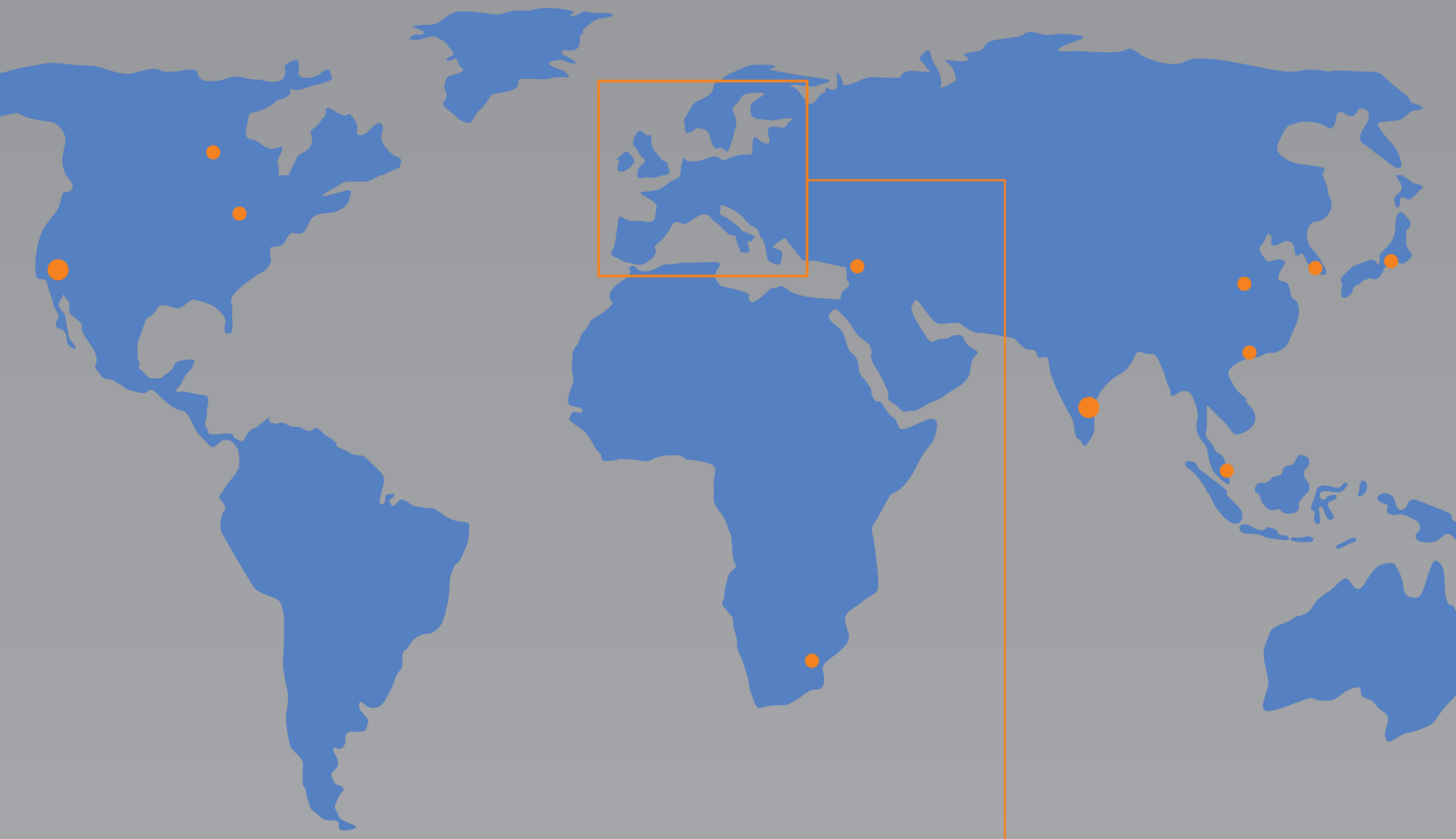

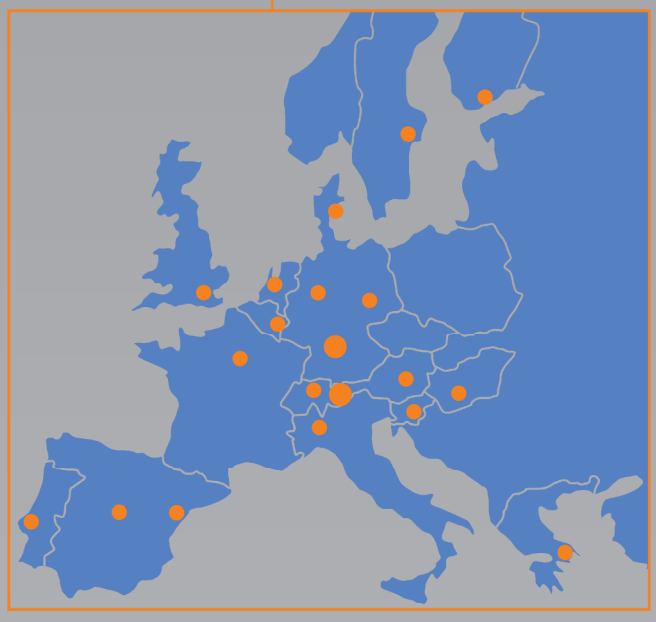

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