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Controllo e misura

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SISTEMI DIAGNOSTICI PER MISURARE LE VIBRAZIONI

di Noemi Sala

PEI VM presenta VMGears, un sistema per la diagnostica di macchine rotanti mediante la misura delle vibrazioni superficiali. Grazie ad algoritmi sviluppati ad hoc, identifica i difetti delle componenti interne che presentano rumorosità e vibrazioni anomale.

PEI VM è una realtà italiana specializzata in consulenza e strumentazione nel campo NVH ("Noise Vibrations Harshness"). Quasi tutti i tipi di macchinari industriali, infatti, contengono al loro interno parti rotanti soggette a urti, strisciamenti, contatti, sbilanciamenti. Questi si traducono in forze di eccitazione che a loro volta, propagandosi per continuità del materiale a tutta la struttura della macchina, generano vibrazioni superficiali, e di conseguenza onde sonore. Le vibrazioni e le onde sonore prodotte da una macchina rotante sono connaturate al funzionamento stesso della macchina, e pertanto sono sempre presenti e quasi sempre rilevabili. Opportunamente processati, tali segnali sono in grado di rivelare importanti informazioni sullo stato di salute o di usura delle componenti interne della macchina. Il valore dell'analisi acustica e vibrazionale è applicabile a tutto il ciclo di vita di un sistema meccatronico: dalla fase di ricerca & sviluppo al controllo qualità sulla linea di produzione, fino alla fase di monitoraggio delle condizioni operative durante test di durata, e durante la reale vita operativa della macchina.

I LIMITI DELLA STRUMENTAZIONE

Fino a pochi anni fa per la diagnosi delle macchine rotanti, sia come controllo a fine linea, sia negli interventi di manutenzione e assistenza, si

VMGears QC: strumentazione fissa per il collaudo a fine linea di produzione.
VMGears QC is designed for the End-Of-Line test on the assembly line.

Diagnostics System for Vibrations Analysis

PEI VM proposes VMGears, a vibration-based diagnostic system for rotating machines. Its "ad-hoc" algorithms identify the defects of components which generate abnormal vibrations and sound waves during machine working.

The Italian company PEI VM is specialized in the field experimental NVH (Noise Vibrations Harshness). Indeed, nearly all kinds of industrial machines contain inner rotating components producing impacts, frictions, unbalances, contacts. These forces excite the machine housing, generating surface vibrations and, consequently, sound waves. These vibrations and acoustic waves are always present, being generated by the natural and basic cyclic functionality of the machine, and can be measured by common commercial sensors. If properly processed, their signals can reveal important information about the healthy status of the internal components. Vibro-acoustic analysis can be applied along the whole life-cycle of the rotating machine: in the research & development phase, in the end-of-line test for assessing the quality of the final product, in the durability monitoring phase, and also in the machine condition monitoring.

The limits of instrumentation

Until some years ago the nearly unique instrument used to monitor rotating machines was the human ear. The discrimination between a healthy and a defective product was up to the sensitivity of the operator, thus not objective and not repeatable. Nowadays, in addition to human ear, several types of sensors and instruments are used, such as sound level meters, vibrometers, thermocouples and oil quality sensors. All these sensors are quite easy-to-use, but have a relatively poor diagnostic value: their indicators are overall levels which can identify big defects and damages, or big deviations from "normal" values (if already measured in the past), but they cannot identify failures in the early stage of development.
The most valuable signal for the diagnostics of a rotating machine, is the

VMGears RD è la versione portatile per misure in sala prove e in campo.

VMGears RD is the portable version for measurements in the testing area or on site.

machine housing vibration: it's quite simple to be measured, but complex to be analysed into details.

Algorithms developed in order to calculate a specific indicator

Since 2004 PEI VM has developed proprietary algorithms based on advanced analysis of vibrations (and other "dynamic signals") in function of the kinematic scheme of the machine under test, i.e. in function of some specific mechanical parameters of internal components such as: the teeth number of each gear, the number or rolling elements of each bearing, or the number of stator slots of an electric drive. The purpose of the algorithms is to calculate a specific indicator for each type of defect of each inner component, for each type of machine.

During these years a wide experimental activity has been done with the support of several manufacturing Italian companies, mainly located in Emilia Romagna, allowing PEI VM to develop specific analysis modules for each kind of rotating machine (gearboxes, axles, gearshifts, electric drives, internal combustion engines, pumps and so on). These modules are available as different software licenses within a multi-ambient diagnostics system called VMGears.

Analysis of housing vibrations

VMGears is a measurement system available in the market since 2006, complete of hardware and software, designed to perform the diagnostics of rotating machines through the analysis of housing vibrations. VMGears algorithms identify the defects of rotating components which generate "abnormal" vibrations or sound waves during machine working.

These defects are shown to the operator by an easy-to-use software interface, as numeric indicators easily comparable, allowing an immediate view on the healthy status of the complete machine.

Three different environments for three applications

VMGears, used today by companies in the power transmission, automotive, motorcycle, off-highway, is structured in three different environments for three different applications: VMGears RD - Research & Development - portable instrument for measurements in the testing area, or on site; VMGears QC - Quality Control - designed for the End-Of-Line test on the assembly line; VMGears DM - Durability Monitoring - designed for the monitoring of durability tests. These three systems are compliant with the requirements of Industry 4.0, with annexed fiscal benefits. VMGears systems belong to IIoT tools, a group of different technologies developed in the last years and targeted to increase the capabilities of control and automation of industrial processes: data from sensors installed on the tooling machines placed on the production line can be continuously acquired and analysed, monitoring each phase of the as well as of the final product and implementing the so-called "intelligent" production. •