FUNDAMENTAL ASPECTS OF ACOUSTIC EMISSION MONITORING

Acoustic emission monitoring is an important part of the surveillance of industrial processes, especially for setting the process parameters or defining the need for repair of a machine or structure needs repair. For example, acoustic emission is particularly useful as a means to locate and characterize cracks and other defects in steel bridges (Figure 1). By deploying an array of transducers around a known defect, or in a high-stress, fracture-critical area where a defect can be suspected, it is possible to locate an active crack or quantitatively determine crack´s growing or extinguishing.

Figure 1: AEM of structural parts of steel bridges

The task of AEM is the detection of characteristics in the acoustic composition of the signal. Basically, this includes the characteristic and system-specific patterns and absolute amplitudes in the frequency range. As the technically occurring vibrations (time signal) are mostly a-periodic, transient events, thus, singular, temporary and subsiding, the spectra can be analysed by transforming the time signals directly into the spectral range with the help of the Fourier-Transformation.

The sound emission is either structure-borne or airborne [1] and can be analysed in its frequency spectrum after measurement. This spectrum is calculated with the help of the rapid Fourier-Transformation (FFT) method [2,3]. The frequencies which are to be measured lie within the audible frequency range (20 Hz – 20 kHz) and the ultrasonic range ($\geq$ 20kHz) [4]. The focus is always on the entire system, including machines as well as testing samples. If a system starts vibrating, the output signal will contain a characteristic response of the system [5], which then can be measured acoustically with the help of sensors for structure-borne and airborne sounds [4]. This measured vibration behaviour shows a time and frequency pattern which is typical for the system. This pattern can then be compared to priorly recorded patterns, based on the vibration behaviour of flawless systems. Thus, the quality of the processing procedure can be evaluated.

A continuous evaluation during the processing period is realised through the acoustic process surveillance. As this quality control is parallel to the process, occurring flaws and defaults can be detected directly through the process-accompanying evaluation of the structure-borne and airborne sounds. This process control is performed by acoustic measurement systems which can be integrated into existing processes. In this case, a

[1]: Möser, M.: Technische Akustik, 9. Auflage, Kapitel 2 und 4, Springer, 2012.
[2]: Ohm, J-R. & Lüke, H.D.: Signalübertragung, 12. Auflage, Kapitel 4, Springer Vieweg, 2014.
[3]: Oppenheim, A.V., Schafer R.W. & Buck, J.R.: Discrete-Time Signal Processing, Second Edition, Chapter 9, Prentice Hall, 1999.
[4]: Hering, Martin & Stohrer: Physik für Ingenieure, 11. Auflage, Kapitel 7, Springer, 2012.
[5]: Beucher, O.: Signale und Systeme: Theorie, Simulation, Anwendung, Springer, 2011.

sensor for structure-borne sounds is mounted directly to the workpiece holder or an airborne sound microphone is placed nearby. As a result, occurring vibrations can be detected directly with the sensors and then evaluated with the help of electronic systems and software for analysis [6,7].

[6]: Medav GmbH: CrackMasterTM Zerstörungsfreie Bauteilprüfung in der Serienfertigung durch akustische Resonanzanalyse, 2015.

[7]: Medav GmbH: Publikation: PM-Anwendungen mit Akustischer Resonanzprüfung, 2015.