**Rotating machine diagnosis using acoustic imaging and artificial intelligence**

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Mass production of quality equipment in the automotive industry requires controls throughout the production line. These controls are done through monitoring and validation tools for both production and finished products. The use of signal processing methods, applied to acoustic and vibratory recordings collected during the operating cycle, aims to ensure that they are in good working order, to maintain them and to guarantee the quality of the service provided by the manufacturer to its customers.

Sometimes the techniques used do not reach the expected performance, which of course depends on the defect to be recognized but also on the conditions under which the measurements were made. Indeed, in a production environment many parts are unfairly detected as defective when monitoring is based on indicators from the literature. The causes of these errors are often related to the not conducive noisy environment to such a diagnosis by indicators sensitive to disturbance. Moreover, from one production site to another, it is not possible to apply the same default detection thresholds because of a different environment involving a variation of the structures and product frequency responses. Therefore, today it remains difficult to do a relevant diagnosis in a noisy environment and particularly on non-stationary signals. The aim of the study is to improve this diagnosis by first using a microphone antenna and then operating an artificial intelligence process on a database acquired on production benches.

The microphone array leads to obtain a spatial map of the acoustic field generated by the monitored system. An acoustic imaging approach allows the addition of a new spatial dimension in the data representation. The preliminary study presented consists in differentiating several states of the system to be monitored from the simultaneous exploitation of information expressed in the time-frequency-space domain.

The system considered is an electric motor composed of several subassemblies such as planetary gear reducer, a drive shaft, an armature permitting under the effect of a magnetic field the rotation of the motor and a current transmission subassembly allowing the current to flow to the armature by brushes. Each subset radiates its own acoustic signal which, by interactions, contributes to the overall signal emitted by this motor. These interactions associated to the resonance phenomena in the transient operating phases of the machine make the diagnosis more difficult. Using an antenna makes the diagnosis less sensitive to disturbance and thus more reliable. Indeed, this one allows to focus the acoustic measurement on the rotating machine by a beamforming process while freeing of the disturbing sources coming from other directions. First results of comparison will be presented.

**Keywords:** nonstationary signals, beamforming, array processing, diagnosis, artificial intelligence, rotating machine

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