

## **Synchronous Analysis for Diagnostics of Rolling Bearings In the Turbo Jet Engine**

**Zdzisław Gosiewski**

*Aviation Institute*

*O2 - 256 Warszawa, Al. Krakowska 110/114, Poland;*

*e-mail : gosiewski@wmt.wat.edu.pl*

**Andrzej Romaniuk**

*Without affiliation*

*O2 – 936 Warszawa, ul. Św. Bonifacego 74 m. 106, Poland;*

*e-mail : andrzej.a.romaniuk@wp.pl*

### **ABSTRACT**

The synchronous analysis is realized by the tracking filter and by the computer synchronous summation. In rotating machinery most of the external excitations are synchronous to the constant factor with the rotor angular velocity  $f_0$ . So more, such excitation as the rotor unbalance causes sub- or multi- synchronous vibrations of the rotating machinery components e.g. of rolling bearings.

Designed in Aviation Institute the turbo jet engine K-15 has a rolling bearing, which answers with the frequency  $5,87 * f_0$  to the unbalance excitation. Signal with this frequency indicates a fault of the outer race of the rolling bearing.

Since K-15 is inbuilt in an aircraft its angular velocity is changing in the wide range. Therefore, the classical Fourier spectrum is useless in the vibration diagnostics of the engine. We designed the tracking filter, which collect the same number of samples during one rotor revolution. The teeth of the gear wheel of the tachometer joined to K-15 were used as the sampling mechanism.

A set of the digital synchronous filters was used for the K-15 vibration spectrum analysis. The procedure of filtration was performed by own computer software. The synchronous summation of the measured signals was carried out before the spectrum analysis. Two cases were considered: the engine with the small force due to unbalance (the rotor perfectly balanced) and the engine with the big unbalance force.

In the case of the perfectly balanced engine the outer race frequency was not observed, despite of the existence of the vibration amplitude with such a frequency before the synchronous summation.

In the case of the engine with the unbalanced rotor, the outer race frequency after the synchronous summation had enlarged amplitude while other spectrum components in its vicinity were damped. It underlines the usefulness of the synchronous analysis in the vibration diagnostics of the rotating machinery.