Evaluating signal processing methods for use in gearbox condition monitoring

Intelligent machinery condition monitoring and damage diagnostics is becoming increasingly important: Meeting low maintenance budgets is of key importance in a more and more globalized and competitive market environment. Being able to detect gearbox damage early and in an automated way allows for extended service intervals, less standstill and decreased total cost. One of the known mechanisms of gear failure is the occurrence of pitting on gear teeth flanks. Advancing pitting damage leads to a shift in the noise excitation behaviour of a gear pair. Common gearbox condition monitoring solution often rely on acceleration measurements on the gearbox case. As a means of excitation behaviour examination, angular position encoders are able to provide high quality data on the gear pair transmission error. These angular encoders work preferably at low rotational speeds. Transmission error is widely used to characterize the tooth flank form and quality relating to noise excitation. Recording and processing high-frequency and high-precision angular shaft positions to utilize them in subsequent flank damage detection at high rotational speeds poses a challenge. An
FZG standard gear test rig was equipped with angular position encoders, acceleration sensors and the corresponding data acquisition units. This sensorial equipment is capable of performing synchronous, high-frequency combined measurements of angular positions of the shafts and acceleration signals on the gear housing. A detailed evaluation shows that an early damage detection with position encoder signals is possible. Different digital signal processing methods were examined and compared regarding their appropriateness for pitting damage detection.