Defect detection of compressors using machine learning on acoustic emissions

Frank Duckhorn[1], Constanze Tschöpe[2], Maximilian Mühle[3], Michael Hennecke[4], Peter Kolbe[5], Steffen Moeck[6], Peter Holstein[4]

[1]Machine Learning and Data Analysis, Fraunhofer Institute for Ceramic Technologies and Systems, Germany, [1]Machine Learning and Data Analysis, Fraunhofer IKTS, Germany, [1]Machine Learning and Data Analysis, Dresden, Germany, [1]., Fraunhofer Institute for Ceramic Technologies and Systems, Germany, [1]., Fraunhofer IKTS, Germany, [1]., Dresden, Germany

Almost every branch of industry uses and relies on compressed air supply. Maintenance of air compressors is important and cost-intensive business but crucial for stable operation and reliable supply of air pressure. We are detecting defects and fault operations of compressors by acoustic observations. We also want to predict defects and faults for scheduling and optimization of services. There is a large variety of defect types as well as normal operation state emissions. Additionally, the relation of acoustic signals and defects is very complex. It is not possible to analytically model the physical relation. Therefore, we use machine learning techniques to automatically train models on previously recorded signals. The models are able to detect and predict defects and faults. The paper will present the latest results of a case study for screw-type compressors (up to 75 kW). In this study, two compressors have been equipped with a set of broadband ultrasound sensors, vibration sensors and microphones. The higher frequencies of the broadband sensors (up to 100 kHz) provide some advantages for the earlier prediction of operational states and lifetime of compressor components due to its sensitivity to small scale vibrations and turbulences caused by vibration effects. We recorded signals in different operation states and with artificial defects. The recordings were analyzed and evaluated using machine learning methods like Support Vector Machines and Deep Neural Networks. With these methods, we can show that defect detection is working well and separation of defects is possible with a small number of sensors. The application of these techniques will enable maintenance services on demand and reduce maintenance costs and production stops strongly.