The aim of conditional monitoring based on artificial intelligence in rotating machines is to monitor the onset and development of degradation before a failure occurs. The degradation will eventually lead to a dysfunction of the system (rolling bearing or gearbox), which will affect the availability of the entire system. Detection at an early stage allows for appropriate planned shutdown to avoid catastrophic failure and, as a result, more reliable operation and lower cost.

This dissertation divided in two essential parts: the first part is concerned to detection and classification faults in rolling element bearings, and the second part is focalized to modeling crack teeth and pitting teeth in the gear systems. The condition monitoring and multi-fault diagnosis of rotating machines is a very important research content in the field of the rotating machinery health management. In this thesis, a novel methodology for rolling bearing diagnosis has been developed which combines between the fuzzy entropy of self-adaptive time-frequency analysis method (EMD), principal component analysis (PCA) and self-organizing map (SOM) neural network to differentiate between Inner race, Outer race, Cage element and Ball in under operation modes and differ size of faults. The fault feature extraction, selection and classification method has been verified using results from the experimental data of bearings. The obtained results confirm that the proposed method is suitable for assessing bearing degradation and obtaining the recognition of high-sensitivity defects for different types of bearing defects.

In the second part of this thesis deals with pitting and crack modeling from a condition monitoring perspective and focuses on the early detection of pitting and cracks propagation and how to differentiate between them in gear teeth using MCSA and Fast Kurtogram. The research approach is based on dynamic modeling of simulation the pitting surface teeth and cracks teeth in gear mesh stiffness. The electromechanical system which is a simple stage spur a 16 DOF gear dynamic model with and without defect driven by a three phase induction machine with effect of pitting and crack faults on the induction stator current signal. The simulated motor current signal is then analyzed by using a Fast- Kurtogram method. Self-organizing map (SOM) neural network is subsequently used to develop an automatic diagnostic system. The method makes it possible to detect and identify and differentiate at an early stage the crack and pitting fault