PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Federico Gargiulo

XXIX Cycle

Training and Research Activities Report – Third Year

Tutor: Pasquale Arpaia

1. Information

PhD student: Eng. Federico Gargiulo, Master Degree in Computer Engineering at University of Naples "Federico II". PhD student in XXIX Cycle- ITEE – Università di Napoli Federico II
Tutor Prof. Pasquale Arpaia

2. Study and Training activities

Seminars:

i. EOS workshop, Mar 2021, Dr. Andreas Peters, Luca Mascetti et al. (4 CFU);

PhD School:

ii. PhD School Italo Gorini, GMEE, 06-10/09/2021 (3CFU).

3. Research activity

In this third year my research activity in the field of predictive maintenance has been focused on the continuation of the research activities on hard disks and on the start and end of the new research field on the diagnostics of electric motors.

Predictive failure system for Hard Disks

I worked on validating the tree machine learning models produced in the second year by carrying out a comparison work with alternative solutions of classifiers proposed in the state-of-the-art literature. In particular, I carried out tests by adopting neural networks, decision trees and support vector machines. The activity highlighted how the proposed and adopted model of the regularized greedy forest is the most efficient in terms of accuracy and false positive rate.
The research work carried out on magnetic hard disks, consisting of techniques for automatic labelling innovative techniques for optimizing hyperparameters has been successfully submitted in the Applied Sciences journal of the MDPI publisher.

Predictive failure system for Induction Motors

In the last part of the PhD I focused on the diagnostics of three-phase asynchronous electric motors. In particular, I studied and explored the techniques for carrying out an analysis of the working conditions of electric motors starting from the supply currents.
The work carried out consists of a new measure driven modeling technique and training of a classifier in order to identify the most common asynchronous motor faults and prevent failures. The novelty of the constructed and proposed methodology consists in the high accuracy (higher than 98%) achieved thanks to a set of techniques adopted for sampling and for the training of the classifier. The modeling took place by means of a feed forward neural network adopted as a classifier and trained on 40 features extracted from the single phase currents.
The work was validated on a case study made up of as many as 28 three-phase asynchronous electric motors that helped build a dataset of 84 samples divided into two classes.

The proposed method is able to reach an accuracy of 98%, much higher than the techniques proposed in the literature in the state of the art. A comparison work was also carried out with other classifiers commonly used in the literature for diagnostics on electric motors. This work further confirmed the validity of the methodology I proposed for the failure prediction of electric motors.

Collaborations:

- European Organization for Nuclear Research (CERN)
- Dipartimento di Ingegneria Industriale Unina

4. Products
   - F. Gargiulo, "The measures' impact in a machine learning application", 23 Dec 2021, (Seminar);
   - F. Gargiulo, D.Duellmann, P.Arpaia, R.Schiano Lo Moriello, "Predicting Hard Disk Failure by Means of Automatized Labeling and Machine Learning Approach", Applied Sciences 11 (18), 8293
5. Activity abroad
   a. CERN project associate in the framework of Failure Detection project between CERN and Dipartimento di Ingegneria Industriale Univerista' degli Studi di Napoli Federico II. May 2019-Apr 2021.

Credits year 3							
	1	2	3	4	5	6	
Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	**Summary**
					3		**3**
		4					**4**
	10	8	10	10	8	10	**56**
0	10	12	10	10	11	10	**63**