

Online health status detection of a motor

1. Excellence

1.1. State of art, knowledge needs and projects objectives:

Determine the continuous health of a motor can be useful to predict a failure and to enable some procedures to put the motor into safety condition. This can also help the engineer to be aware of the type of the failure.

Actually, most technique use contact sensor, for example: temperature sensors or vibrometers. The temperature sensor is used to estimate the temperature of the inner components of the motor because temperature causes a degradation reducing their lifespan. Is also possible to use vibrometers/accelerometers attached on the shaft to determine vibration; this data is used to determine failure of the bearings of the motors. However, this project wants to purpose a method to determine the health status of the motor using non-contact sensors and non-destructive testing to do this we need knowledge about data analytics, neural network and lidar sensor.

1.2. Research question and hypotheses, theoretical approach and methodology

This project wants to answer to the question: is possible to determine if the health status of the motor is good or bad using only a lidar? The lidar, pointed to the motor's shaft, can read the speed of the motor's shaft. The speed data feeds an ANN which can determine the status of health. The ANN will be trained injecting known fault in the motor by varying the current or the load. Then, after the training, it should be able to detect the bad health of the motor and is also possible to retrace the type of fault using reverse engineering, for example a variation of load of current in the motor. And if the condition of the motor is outside the acceptable range, for example for the speed, the system must stop the motor.

There may be risk that might endanger achievement of the project: the training sets for the CNN could be too large to train the neural network to identify every fault case.

1.3. Novelty and Ambition:

A lidar is a non-contact sensor, that can be used to determine the speed of the motor, so to apply this technique the motor must not but modified. In fact, the actual technique requires to put a sensor on the motor, this could be very difficult if the motor is in hostile and uncomfortable places like for example on the wind turbine. Also, this sensor must be rugged and durable to the hard condition in which the motor could works, so this reduces the lifespan of the sensor and their reliability. Using contact-sensor requires t o modified the motor, for example: using a vibrometer to determine the vibration of the shaft requires a appropriate balanced shaft. In addition, light-based sensor, as Lidars, can be more reliable and precise than a contact sensor.

2. Impact

2.1. Potential for academic impact of the research project

The output of this project could raise new academic challenges. Determinate the continuous health status of a motor can helps to develop different type of predictive maintenance. For example, is possible to estimate the remaining useful life of the motor to schedule a maintenance before the failure appear; this helps reducing drastically the downtime of a machine. The application of different and more efficient ANN makes possible to immediately detect the precise fault in the motor. In addition is possible to add new sensor to detect different fault of the motor. Or used the data coming from the fault-detection system to improve a more efficient control.

- 2.2. The project's target audience is composed by all researcher whose need to implement different types of fault detection in motors, to improve their predictive maintenance scheme. But also, for who want to improve non-contact control of a motor, because it is allocated in a hostile environment for classic contact sensors.

3. *Implementation*

3.1. *Project organisation and management*

The project will be divided in different tasks: at the beginning we proceed with the selection of the suitable sensor and its regulation. After the sensing part, we continue with the implementation of the neural network and its communication with the sensing system. In the end, the ANN must be trained with some specific examples in the laboratory. Once the neural network works correctly, is possible to proceed with the reverse engineering phase in which the system tries to understand the fault.

LINK TO THE GITHUB REPOSITORY: [here](#)

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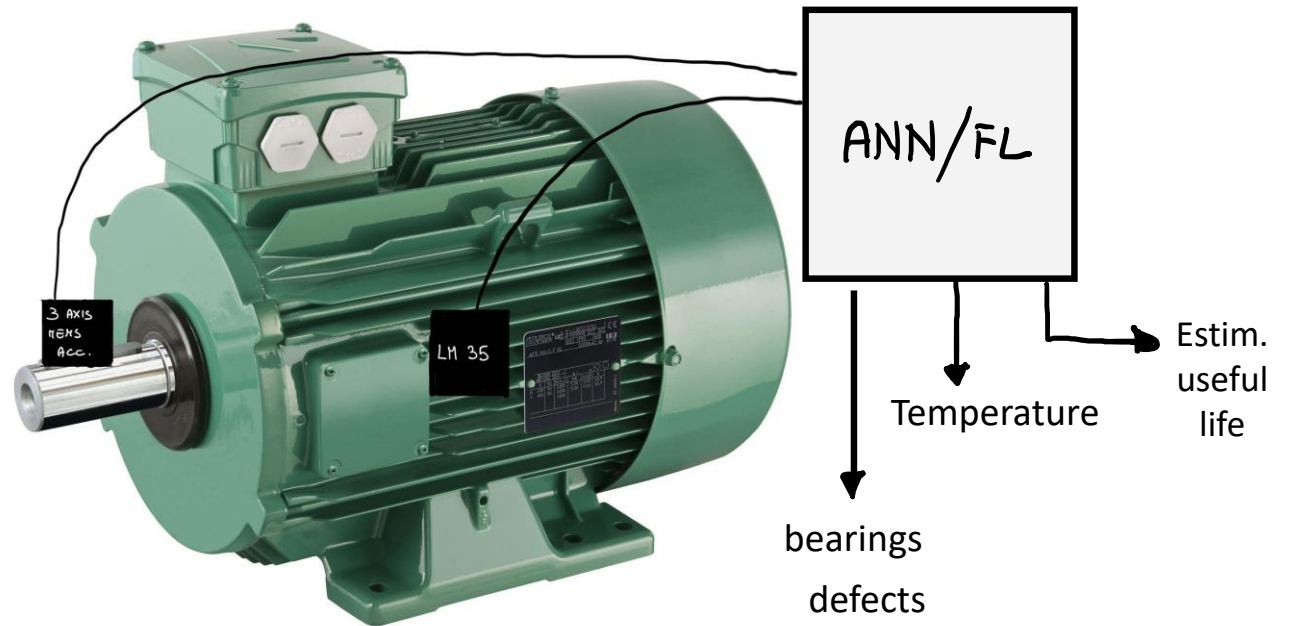
PROBLEM: Is possible to determine the health status of the motor continuously using non-contact sensors and non-destructive testing?

State of art:

Detection of the health status of the motor using **contact sensor** such as:

- Temperature sensor
- Vibrometer/accelerometer

Can estimate the remaning useful life of the motor using contact sensors and an artificial neural network combined with a fuzzy logic.

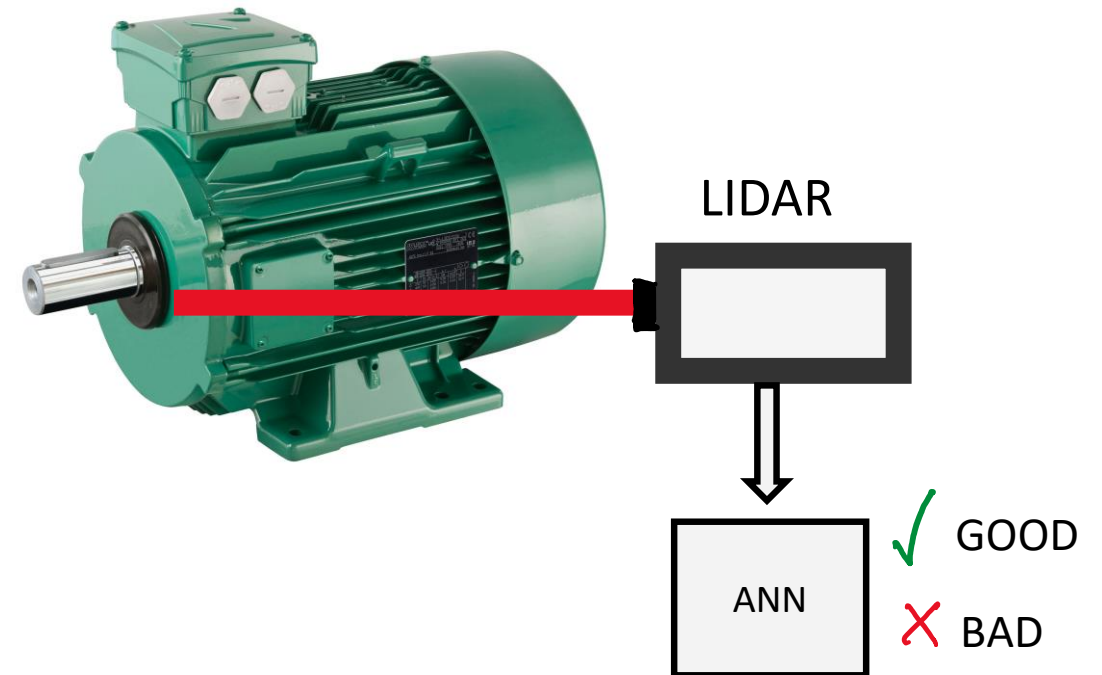


Project's aim

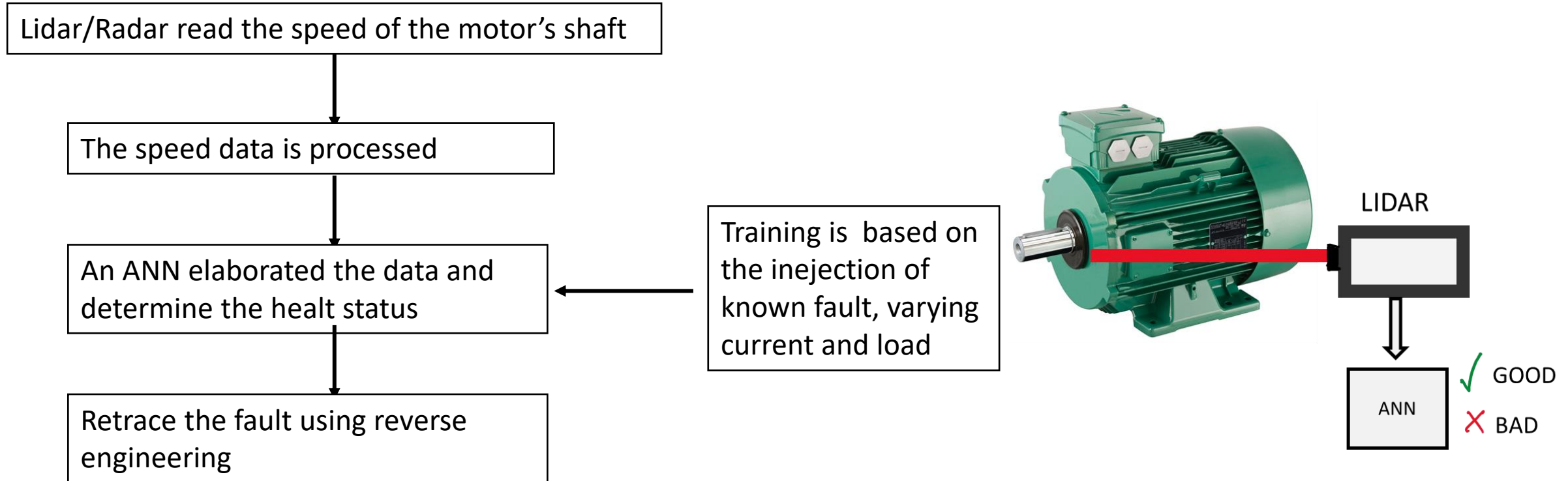
The aim is to determine the continuous health status of the motor using a non-contact sensor that measures the speed of the motor.

PROS:

- Non intrusive monitoring system
- Mostly independent from environment condition
- Retrace the fault



Process



Future applications and developments

Condition monitoring without contact with the object can be very useful when the motor is placed in hostile or not very accesable enviroment.

The data from the sensing components can be used for the control system of the motor, improving efficiency.

The health of the motor can helps to develop new predictive maintenance technique, reducing the costs of industrial installations.

