DEFECT DETECTION AND TRACING ON HELICOPTER ROTORS BY ARTIFICIAL NEURAL NETWORKS

Hervé Morel*, Mustapha Ouladsine Tomasz Krysinski* and Daniel Brun-Picard****
*** Dynamics Department Eurocopter**
Marignane, France

**** LSIS UMR CNRS 6168**
Université Paul Cézanne, Aix-Marseille III
Av Escadrille Normandie Niemen 13397 Marseille France

herve.morel@eurocopter.com
Tel: + 33 4 91 05 60 62 Fax: + 33 4 91 05 60 33

This paper describes a method that employs neural networks to detect and trace defects on helicopter rotors. The method analyzes signals of vibration measurements on the helicopter airframe to perform a diagnosis of the rotor before the rotor-tuning phase. The experimental phase – the basis of this paper – focuses on the behavioral analysis of the neural network with the aim of classifying the vibration signatures generated by a parametric model of the helicopter. The method employs competitive learning neural networks to discriminate between the signatures or images of the rotor defects.

The problem concerns the failure of the mechanical and/or hydraulic components used in the various types of helicopter rotors. The defects in this study are on the main rotor, which generates the helicopter's lift.
No scientific or automatic method available today can replace the expertise of the specialists, i.e. the pilots, design engineers and flight engineers. Moreover, this expertise is specific to each type of helicopter and to each type of dynamic component (rotor, etc.)

The methodology applied in this paper is based on having representations of each of the system's states (normal operation and operation with defects), then on discriminating between these states in a manner similar to pattern recognition methods. However, such a situation is ideal and is very unlikely to be encountered in practice. The systems to be monitored are too expensive and/or too critical, so that any thought of injecting the defects into them has to be dismissed.
The methods for classifying data by neural networks ("black box" modeling) appear suitable for the discrimination of vibration signatures representing the states of the system.