EXCITING COIL OPTIMIZATION CRITERIA FOR EDDY CURRENT DETECTION OF SMALL CRACKS UNDER FASTENER HEAD

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Abstract *– The aim of this paper consists of presenting optimization criteria of coil dimensions and the exciting field frequency in order to improving eddy current probe sensitivity for small and deep cracks under fasteners. To accomplish this task, we have studied the influence of coil inner radius, coil height and exciting frequency on probe sensitivity. Then, an algorithmic searching technique is applied to determine the optimal values of the previous parameters. Hence, the obtained results have revealed that the optimum inner radius corresponds exactly to the fastener head outer radius. Furthermore, it has been noticed that as well as the coil height is reduced while keeping the same number of turns, the probes sensitivity increases. Indeed, the use of stacking flat micro-coils is well adapted. In addition, the calculation of the optimum values of the frequency demonstrate that this parameter depend relatively on the defect position, its radial and vertical depth.*

Keywords: *Cracks Under Fasteners; Probes Sensitivity; Coil Dimensions; Optimization Procedure; Eddy Current Testing.*

1. Introduction

The detection of cracks under fasteners (CUF) is an important problem in nondestructive evaluation of multilayer aircraft skin structures [1]. Eddy-current nondestructive testing (EC-NDT) are generally used in the inspection of aircraft skin for the detection of subsurface cracks. However, detection of deep or second and third layer CUF is challenging because the weak eddy-current (EC) signal due to a subsurface crack is dominated by the strong signal response from the fastener [2-3]. So, an optimized sensor must induce the greatest eddy currents density near the crack, in order to obtain the greatest sensor response [4]. Detection and the characterization of defect existing in the material as a loss of material. However, other defects can appear this can be done by using adapted finite element package with parameters studies. In our study, the considered parameters are successively the coil inner radius, coil height and the exciting field frequency.

Qualitatively, the optimal value of each parameter corresponds to the better interaction between the sensor and the defect. Quantitatively, the optimum value is obtained when the impedance variation, caused by the presence of the defect is maximal [5]. After this investigation, we shall give the criteria to be considered by designers to improve the sensors sensitivity for small cracks under fasteners. This study can be extended to pulsed eddy current systems in order to complete previous work, in which some parameters are studied, such as pulse widths that give different depth information based on the frequency components associated with different duty cycles [6].

2. Geometry of the Studied Device

Fig. 1 shows the geometry of a sample part. The absolute probe made of copper operates above three aluminum layers riveted with fastener and made of titanium. The exciting current is sinusoidal with a frequency of 1.6 kHz.

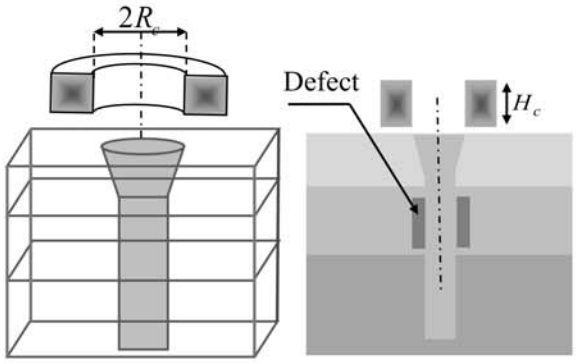

Fig.1 Geometry of the studied device and the studied