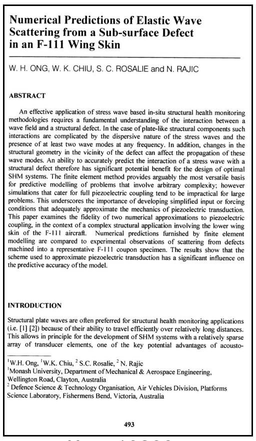

Numerical Predictions of Elastic Wave Scattering from a Sub-surface Defect in an F-111 Wing Skin

W. H. ONG, W. K. CHIU, S. C. ROSALIE and N. RAJIC

ABSTRACT

An effective application of stress wave based in-situ structural health monitoring methodologies requires a fundamental understanding of the interaction between a wave field and a structural defect. In the case of plate-like structural components such interactions are complicated by the dispersive nature of the stress waves and the presence of at least two wave modes at any frequency. In addition, changes in the structural geometry in the vicinity of the defect can affect the propagation of these wave modes. An ability to accurately predict the interaction of a stress wave with a structural defect therefore has significant potential benefit for the design of optimal SHM systems. The finite element method provides arguably the most versatile basis for predictive modelling of problems that involve arbitrary complexity; however simulations that cater for full piezoelectric coupling tend to be impractical for large problems. This underscores the importance of developing simplified input or forcing conditions that adequately approximate the mechanics of piezoelectric transduction. This paper examines the fidelity of two numerical approximations to piezoelectric coupling, in the context of a complex structural application involving the lower wing skin of the F-111 aircraft. Numerical predictions furnished by finite element modelling are compared to experimental observations of scattering from defects machined into a representative F-111 coupon specimen. The results show that the scheme used to approximate piezoelectric transduction has a significant influence on the predictive accuracy of the model.

INTRODUCTION

Structural plate waves are often preferred for structural health monitoring applications (i.e. [1] [2]) because of their ability to travel efficiently over relatively long distances. This allows in principle for the development of SHM systems with a relatively sparse array of transducer elements, one of the key potential advantages of acousto-

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Ключевые слова:

Содержание.