UNIVERSITI TEKNOLOGI MARA

THE RECONCILED FINITE ELEMENT MODEL OF RIVETED JOINTS STRUCTURE FOR CRASH ANALYSIS

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ABSTRACT

In the automotive structure, a different type material structure partially employing aluminium alloy sheets may be adopted in order to achieve higher strength and better formability for light weighting and crashworthiness. The structures are assembled from components connected by various types of joints and the dynamic properties of the joints are difficult to incorporate in the model numerically accurately due to invalid assumption of input values. The accuracy of the predicted model is significantly affected by the input properties of the joints. In this research, the dynamic behaviour of a simplified model of crash box structure that is joined by a number of riveted joints was investigated. Different types of connector elements were investigated and their accuracy was discussed in terms of natural frequencies and mode shapes. In order to achieve these goals, the predicted results are compared with the experimental data. Moreover, the re-conciliation method known as iterative finite element model updating is used to minimise the discrepancy between the experimental results and the predicted results of finite element model of crash box. In this research, the effectiveness of updated model of the crash box is then used for the crash analysis using crash simulation ABAQUS/explicit, and at the end of this research, the updated model was compared with the initial model in terms of Crush Force Efficiency (CFE), Initial Peak Force (IPF) and Specific Energy Absorption (SEA). Based on evaluation of the crash data, all of the relative errors of the three criteria of impact response of updated model were found closer to the experimental drop test in comparison with the initial model of the double hat shape. It is shown that the updated finite element model of the crash box provides a better correlation with the crash experimental result.

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CHAPTER ONE
INTRODUCTION

1.1 Overview

Modem computers, which are capable of processing large matrix problems at high speed; have enabled the construction of large and sophisticated numerical models, and the rapid processing of digitized data obtained from analogue measurements. The most widespread approach for numerical modelling in engineering design is the finite element method [1]. The Cooley-Tukey algorithm, and related techniques, for Fast Fourier Transformations have led to the computerisation of long established techniques, and the blossoming of new computer intensive methods, in experimental modal analysis [1]. For various reasons, to be elaborated upon in the chapters that follow, the experimental results and numerical predictions often conspire to disagree. Thus, the scene is set to use the test results to improve the numerical model. It would be superficial to imagine that updating is straightforward or easy: it is beset with problems of imprecision and incompleteness in the measurements and inaccuracy in the finite element model [2]. In model updating the improvement of an inaccurate model by using imprecise and incomplete measurements is attempted. In some cases, the only requirement of the updated model is that it should replicate the physical test data. Consider the updating of a turbomachinery model. If measured natural frequencies and mode shapes were available. Then an updated model which reproduced such data might be quite useful for comparison with data obtained at another time or from another machine [3]. If the model had been improved, not only with the intention of mimicking the test results but also by improving the physical parameters (upon which depends the distribution of finite element masses and stiffnesses), then it might be possible to locate a fault in a bearing, or a crack in a rotor which is responsible for the observed disparity between measurements and predictions. This can possibly be achieved by using the machine run-down data, which are readily available from large turbo-generator sets, and would eliminate the need for special modal tests that might involve considerable down-time of the machine.