Image Cover Sheet

CLASSIFICATION	SYSTEM NUMBER
UNCLASSIFIED	510320

TITLE

DEVELOPMENT OF COMPUTATIONAL ALGORITHMS FOR PROBABILISTIC FRACTURE MECHANICS

System Number:

Patron Number:

Requester:

Notes: Paper #15 contained in Parent Sysnum #510305

DSIS Use only:

Deliver to: DK

#510320 (15)

DEVELOPMENT OF COMPUTATIONAL ALGORITHMS FOR PROBABILISTIC FRACTURE MECHANICS

By

I.R. Orisamolu, Q. Liu and M.W. Chernuka

Computational Mechanics Group
Martec Limited
Suite 400, 1888 Brunswick Street
Halifax, Nova Scotia, Canada, B3J 3J8

ABSTRACT

Probabilistic fracture mechanics is increasingly gaining recognition and acceptance as the most realistic framework for assessing the integrity of engineering structures that are susceptible to fatigue crack growth and fracture. This is due to the fact that the presence of aleatory uncertainties in material properties, geometry and loads and the epistemic uncertainties associated with modelling and application of fatigue damage and fracture strength formulations are best accounted for using stochastic models. The merit of this approach has long been recognized by the nuclear and aerospace industries where fatigue/fracture failures could be of catastrophic proportions. It is not surprising, therefore, that most of the existing computer programs for probabilistic fracture mechanics were developed by these industries. However, the programs are mostly proprietary and are generally not available in the public domain. Furthermore, most of the programs are based on simulation schemes which are prohibitively expensive especially for application to large-scale structures such as submarines or ships.

A corporate research and development effort was recently initiated at Martec to develop generic and specialized computer programs that could be routinely utilized for probabilistic reliability analysis of structures prone to a variety of failures. A software package COMPASS (acronym for Computer Methods for Probabilistic Analysis of Structures and Systems) has been developed to meet the needs of affordability and accessibility of a practical computational tool that can be applied for risk assessment. Algorithms for efficiently calculating the reliability indices and failure probabilities corresponding to defined limit state conditions were implemented. These include accurate approximate methods such as first-order reliability methods (FORM) and second-order reliability methods (SORM) for single defect problems and probability bounding techniques and the PNET procedure for multiple-site defect/damage problems. Also implemented in COMPASS are facilities for computing various probabilistic sensitivity measures which are useful for identifying the parameters which have the most significant influences on structural reliability. In this paper, some of these features are briefly reviewed and verification problems on fatigue damage and crack growth reliability are presented to illustrate the capabilities of COMPASS.