# Treatment of uncertainties in structural reliability

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## 1 INTRODUCTION

There is no generally accepted methodology to deal with uncertainty and, moreover, there is no generally accepted definition of uncertainty.

Different meanings (e.g. imprecision, vagueness, incompleteness, etc.) are currently given to that word, referring to different attributes that may affect data and information and need different analytical tools and procedures to be handled, Lucia (1985 a, 1985 b).

## 2 THE PROBLEMS OF THE TIME-STRUCTURE OF DATA AND OF THE NON HOMOGENEITY OF INFORMATION SOURCES

From the point of view of reliability assessments, two problems are of central relevance:

1) the time-structure of data and the capability of taking advantage of it to progressively improve the reliability assessment and to optimize decision;
2) the merging and combination of pieces of information of different nature and coming from different sources.

The former of the two is strictly connected with the problem of periodic updating of any estimate (e.g. of residual lifetime, safety margins, etc.) carried out on the behaviour of structures subject to accumulation of damage: this updating is particularly difficult when, as is most real structures, the fresh data coming from monitoring and inspection techniques, applied during service, are very few.

This fact actually leads to the practical impossibility of finding a soundly based likelihood function and, consequently, of correctly applying Bayesian techniques.

Different approaches have to be followed.

Furthermore, while in the prevailing models and theories of decision making only marginal attention has been given to the time dimensions, the decision is intimately linked with time, as explained by Volta (1985).
Volta points out how the connection between time and uncertainty can be considered from different points of view.
From an informational point of view, time changes information and, generally, reduces uncertainty: various strategies can be used (linked to the type of rationality one adopts) to exploit the time structure of information.

The second problem can be tackled by the use of non standard--logics and by the implementation of knowledge-based systems relying on a set of metarules, semantic nets and frames established for combining the evidence that may come from different sources. Both heuristic and formal methods have to be used to characterize the relationships existing among the different rules.
Fuzzy set theory can be chosen, as explained by Garribba and Lucia (1987), as the basis for the knowledge paradigms because it provides a powerfull mathematical tool for establishing a common framework and representing the implication aspects of the reasoning process.

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