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STOCHASTIC AND SENSITIVITY ANALYSIS WITH MISSING DATA

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ABSTRACT

In recent years, many advances have been made in developing new utilization of modern technology enabling the design of structures of unusual parameters. At present there occurs an enormous development in civil engineering, relating to the field of probability and fuzzy probability based methods for the review and assessment of structural reliability showing that there is concordance between reality and the evaluation results with regard to the service life of a structure, reasonable degree of reliability and optimization of the total costs (in relation to the total life cycle of the structure). The basic problems that need to be tackled in practice include: the review of safety, serviceability and lifetime of the load carrying engineering structures.
By combining he model-free forecasting with a computational model it is possible to generate time series comprised of non-measurable physical parameters [3]. Non-measurable physical parameters in engineering include, e.g., characteristic parameters for describing the damage state, robustness or safety and reliability level [3]. These are computed with the aid of a computational model [3]. Computational models include, among others, finite element models or models for computing failure probability [3].

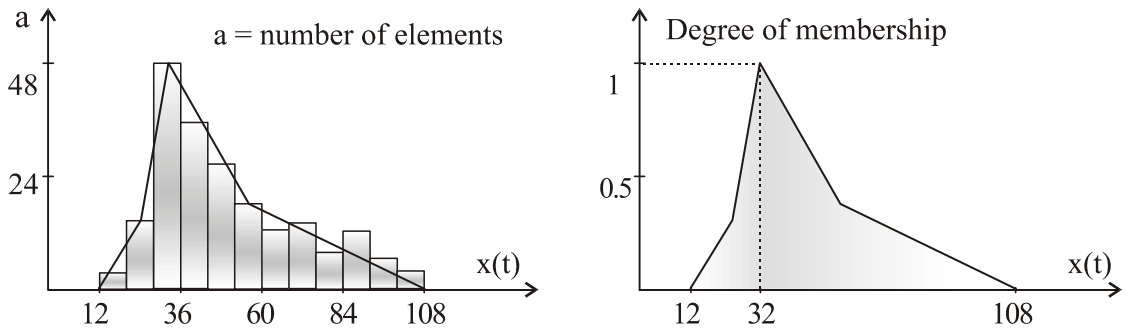

Fig. 1: Histogram and fuzzification of the one day load action measurements

Pure stochastic modelling of the available data by means of multivariable analysis and forecasting methods for real-valued time series is possible only if valid observations are available (e.g. dead load or material and geometrical characteristic of hot-rolled members). The minimal information is at our disposal on variable load action of structures the aleatory character of which can vary significantly in dependence on time. The information can be compiled on daily observation basis in the form of a histogram, and fuzzified. A typical histogram of the variable load action measurements during one day using the membership function is shown in Fig. 1.

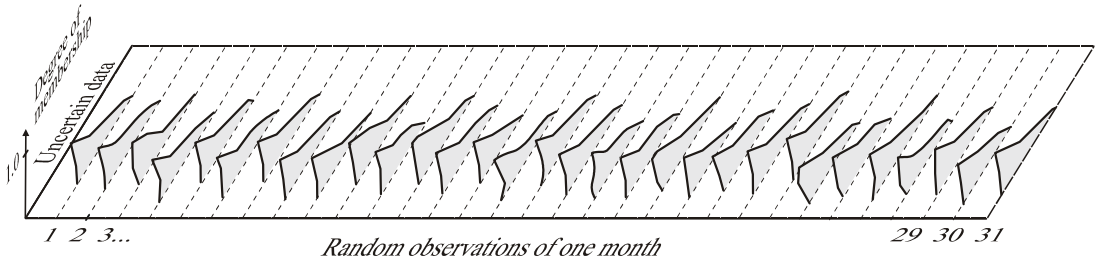

Fig. 2: Time series of the variable load action

The application of fuzzy stochastic methods is especially recommended for very small sample sizes (a very small). The fuzzy time series obtained by this means during one month observation is shown in Fig. 2. Plot of selected α-cuts support (degree of membership zero) and kernel (degree of membership one) are shown in Fig. 3.

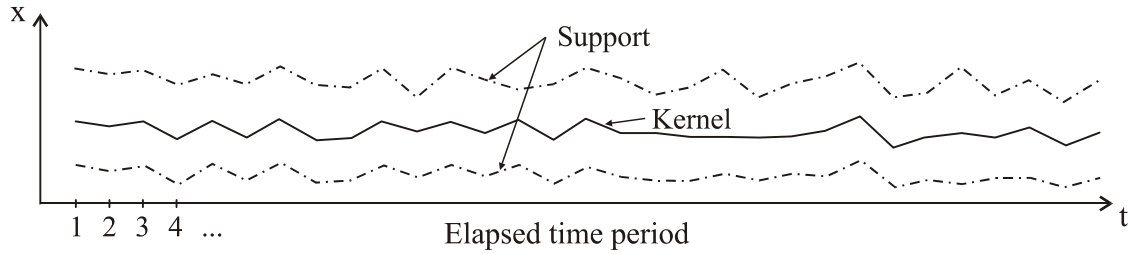

Fig. 3: Time series of the variable load action

In order to continue proceeding, the fuzzy mean value and other fuzzy statistical moments can be utilized. Fuzzy random variables couple the uncertainty models of fuzziness and randomness [2]. Sensitivity analysis can be applied for solving to what degree input parameters influence a monitored output [1].

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