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OBJECT-ORIENTED TIME VARIANT STRUCTURAL RELIABILITY ANALYSIS

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ABSTRACT

This paper presents the development of a high-level computer code for time variant structural reliability analysis. A stand-alone structural reliability platform is developed, which can be linked to different structural analysis codes. Examples of integration with a commercial finite element package are shown.

The structural reliability platform is developed based on the modern object-oriented paradigm and implemented in FORTRAN 95. It takes full advantage of data abstraction, data encapsulation and composition in the definition of random variable and random process classes (Tables 1 and 2). Through the use of pointers, run-time polymorphism of discrete and continuous random processes is supported (Table 3). This allows code to be written generically to handle both types of random processes.

Time-invariant (random variable) reliability algorithms available in the platform include design point search, first and second order methods, bi-modal system probability bounds, construction of response surfaces, simple and importance sampling Monte Carlo simulation. Time variant reliability analysis (Figure 1) is available through out-crossing rate evaluation, load combinations, total probability integration and fast probability integration.

Table 1: Continuous Random Variable (CRV) class implementation

derived data type:	*continuous random variable*
parameters:	probability distribution parameters: P1, P2, P3 and P4 central moments: mean, standard deviation, squew, kurtosis, ...
funcionality:	probability density function; cumulative distribution function; inverse of cumulative distribution function; creation, destruction and printing of continuous random variables; evaluation of central moments for given distribution parameters; evaluation of distribution parameters for given central moments

Table 2:Discrete Random Process (DRP) class implementation

derived data type:	*discrete (mixed)random process*
parameters:	probability of zero-intensity pulses (p) pulse intensity (continuous random variable - composition) pulse arrival rate (continuous random variable - composition)
funcionality:	probability density function; … ; barrier crossing rate; extreme value distribution; creation, destruction and printing of discrete random processes;

Table 3: General random process (RP) class implementation

derived data type:	*random process*
parameters:	discrete random process pointer continuous random process pointer
funcionality:	associate discrete process; associate continuous process; barrier crossing rate; extreme value distribution; ...

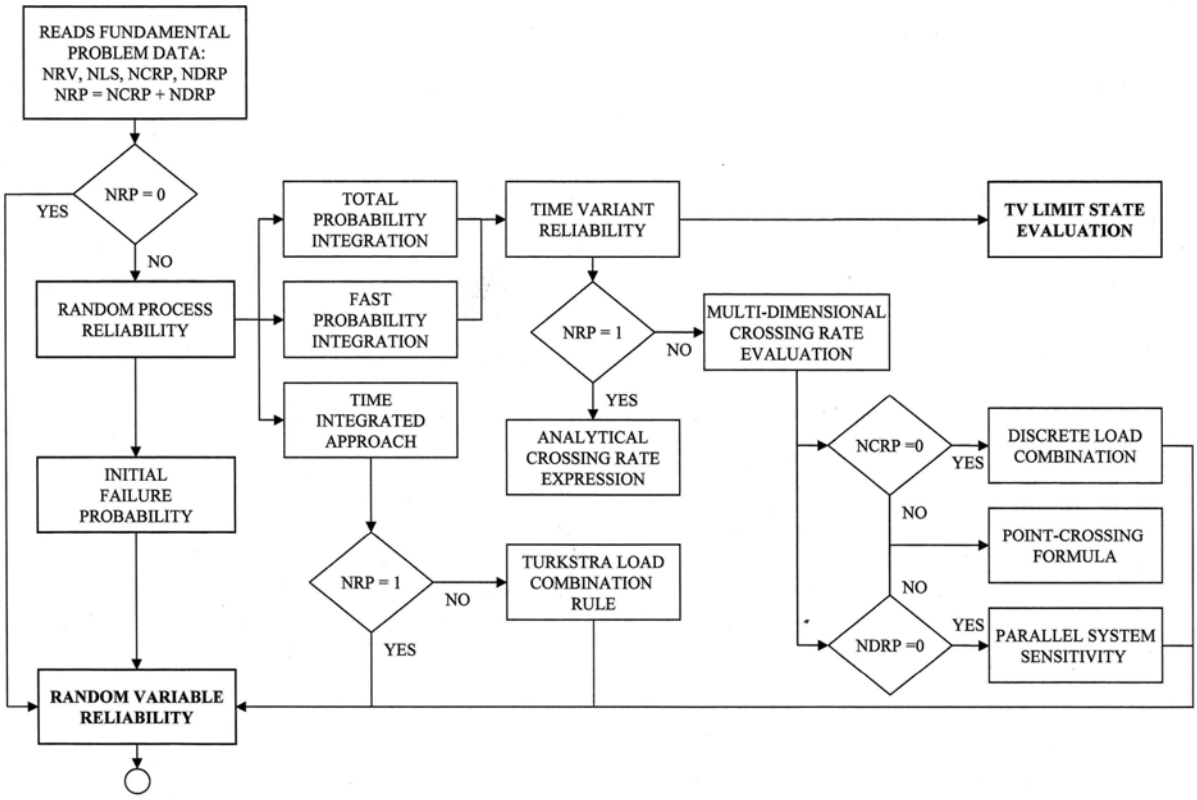

Figure 1: Time-variant (random process) reliability analysis flowchart.

REFERENCES

[1] Hagen, O. and Tvedt, L., 1991: *Vector Process Out-Crossing as a Parallel System Sensitivity Measure*, Journal of Engineering Mechanics, Vol. 117, No. 10, pp. 2201 - 2220.

[2] Haukaas, T. and Kiureghian, A.M., 2000: *An Object Oriented Platform for Finite Element Reliability Analysis*, Proceedings of the 8th ASCE Specialty Conference on Probabilistic Mechanics and Structural Reliability.

[3] Madsen, H.O. and Tvedt, L., 1990: *Methods for Time-Dependent Reliability and Sensitivity Analysis*, Journal of Engineering Mechanics, Vol. 116, No. 10, pp. 2118 - 2135.

[4] Melchers, R.E., 1999: *Structural Reliability Analysis and Prediction*, second edition, John Wiley and Sons, NY.

[5] Wen, Y.K. and Chen, H.C., 1987. *On Fast Integration for Time-variant Structural Reliability*, Probabilistic Engineering Mechanics, vol. 2, no 3, pp 156 - 162.