Contribution ID: **29** Type: **not specified**

RELSYS : A new method based on damage physical-chemical processes with uncertainties and hazard.

Friday, 20 May 2022 14:40 (20 minutes)

Jerome de Reffye
Engineering Degrees from Gustave Eiffel University (ESIEE)
and Pierre et Marie Curie University (Paris VI)
PhD in applied mathematics and theoretical physics
from Pierre et Marie Curie University

On opposite way of empirical approachs we develop an analytic method in Reliability - Maintainability - Availability - Safety (RAMS) area which led to the RELSYS model, (RELiability of SYStems), allowing to take into account all the physical-chemical parameters of the degradation models of the system components as well as their uncertainties in a model of randomized physical-chemical evolution allowing the complete calculation of the probabilities of their failures. This calculation is sufficiently complete to be compatible with the actuarial calculation of insurance, both of which allow the association between the RAMS and the calculation of the guarantee of the system costs.
We show that it is possible, with precise calculations, to evaluate the risks of uninsurable systems by time series because of the lack of data due to the rarity of the feared events. The probabilities of occurrence of these events being very low, the calculations must be based on justified models.
It uses the Langevin's equation for phenomena that evolve slowly over time. The notions of Limit State in Service and Ultimate Limit State are introduced.
This model gives access to dynamic reliability which studies time-dependent phenomena and provides failure probabilities as functions of time through numerical simulation.
We obtain random functions of time whose parameters are themselves random. The uncertainties are thus divided into two parts according to their origin: Uncertainties on the physical-chemical parameters (randomness concentrated at the origin) and uncertainties on the realization of the degradation processes (randomness distributed in time).
We thus obtain the failure probabilities with their confidence intervals. The numerous examples show that RELSYS can be applied to any man-made system. We show the importance of taking into account the probabilistic aspect of the problem from the beginning of the modeling and to develop determinism within the random model. Finally, for the solution of particular problems, one will find original methods in signal processing.
The RELSYS application into system maintenance is using classical theory of random processes. The preventive maintenance parameters can be calculated by RELSYS from the failure probabilities and the technical specifications about the residual failure probabilities. The corrective maintenance cost can be deduced from the previous analysis.
The application of RELSYS to the calculation of the cost of the commitments of guarantees of a program uses the concept of Value at Risk. The used techniques are derived from reinsurance.
We will show numerous examples illustrating the theory by practice in engineering. RELSYS supplies a whole tool to dynamical RAMS analysis.

Primary author: DE REFFYE, Jerome (individual researcher (retired))

Presenter: DE REFFYE, Jerome (individual researcher (retired))

Session Classification: Reliability models