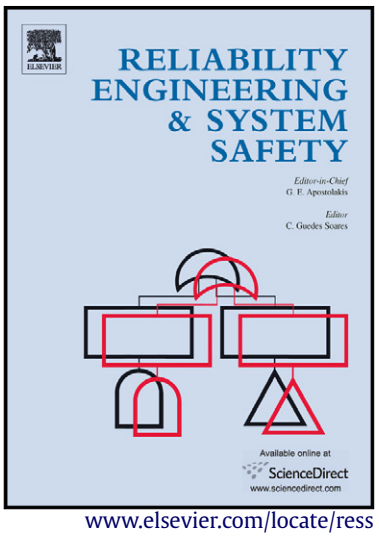

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Comparing the Treatment of Uncertainty in Bayesian Networks and Fuzzy Expert Systems Used for a Human Reliability Analysis Application

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Abstract

The use of expert systems can be helpful to improve the transparency and repeatability of assessments in areas of risk analysis with limited data available. In this field, Human Reliability Analysis (HRA) is no exception, and, in particular, dependence analysis is an HRA task strongly based on analyst judgement. The analysis of dependence among Human Failure Events refers to the assessment of the effect of an earlier human failure on the probability of the subsequent ones. This paper analyses and compares two expert systems, based on Bayesian Belief Networks and Fuzzy Logic (a Fuzzy Expert System, FES), respectively. The comparison shows that a BBN approach should be preferred in all the cases characterized by quantifiable uncertainty in the input (i.e. when probability distributions can be assigned to describe the input parameters uncertainty), since it provides a satisfactory representation of the uncertainty and its output is directly interpretable for use within PSA. On the other hand, in cases characterized by very limited knowledge, an analyst may feel constrained by the probabilistic framework, which requires assigning probability distributions for describing uncertainty. In these cases, the FES seems to lead to a more transparent representation of the input and output uncertainty.

Highlights

- We analyse treatment of uncertainty in two expert systems.
- We compare a Bayesian Belief Network (BBN)and a Fuzzy Expert System (FES).
- We focus on the input assessment, inference engines and output assessment.
- We focus on an application problem of interest for human reliability analysis.
- We emphasize the application rather than math to reach non-BBN or FES specialists.

Keywords

Expert judgement; expert models; Bayesian belief networks; fuzzy fogic; human reliability analysis; dependence assessment