OC - (26091) - A DYNAMIC HUMAN RELIABILITY ANALYSIS APPROACH USING CONTINUOUS MARKOV CHAIN MONTE CARLO METHOD: MODELLING HUMAN ERROR PROBABILITY UNDER PERSISTENT ENVIRONMENTAL DYNAMICS

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The enhancement of Human Reliability Analysis (HRA) is crucial to ensuring nuclear safety, owing to its pivotal role in evaluating human performance under accident scenarios, such as those considered in Probabilistic Risk Assessment (PRA). Conventional HRA techniques typically estimate Human Error Probability (HEP) by referencing Performance Shaping Factors (PSFs) under static conditions; however, such methods are insufficient for capturing the effects of evolving environmental dynamics.

The aim of this study is to develop a computational framework that accommodates the influence of continuously changing environmental conditions in the estimation of HEP. To this end, the Continuous Markov Chain Monte Carlo (CMMC) method is incorporated into the traditionally static HRA to simulate dynamic human task processes. Specifically, at each designated timestep, the corresponding PSFs are systematically updated based on monitored environmental variations, and their effects are reflected within the continuous Markov chain process. These updates are subsequently integrated into the Monte Carlo sampling procedure, enabling a time-dependent determination of task completion. Furthermore, a computational framework is proposed that integrates this CMMC-assisted HRA to account for the cyclic, dynamic, and bidirectional interaction between human performance and the surrounding environment throughout the task process. Ultimately, the HEP under persistent environmental dynamics can be estimated by analyzing the historical data generated from these simulated dynamic tasks.

A hypothetical case study applying the proposed framework is also presented in this study, demonstrating its capability to quantitatively capture the previously unexplored influence of dynamic environmental conditions on repair tasks.

Palavras-chave : Dynamic human reliability analysis, Continuous Markov chain Monte Carlo method, Dynamic interaction between human and environments, Performance shaping factors, Human error probability