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Data-Driven Risk Analysis Of Rare Events Based On Virtual-Reality-Generated-Data

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Risk analysis results are beneficial to the risk control of major accidents. Risk analysis of major accidents has attracted increasing attention from academia, industry, and society. In particular, there is a high requirement of safety in the emergency process of major accidents. Therefore, it deserves to conduct the risk analysis of emergency operations in major accidents. Regarding to major accidents and associated emergency processes, due to the data deficiency, virtual reality (VR)-generated data acts as an alternative to support the risk analysis of emergency operations. In this paper, we propose a method for data-driven risk analysis of emergency operations in major accidents based on VR-generated data. Firstly, a VR model of emergency operations is established. Secondly, data from VR model is generated for the risk analysis of emergency operations. Eventually, the data-driven risk analysis model is constructed aiming at risk prevention and control of emergency operations. The proposed method is validated through a spilled oil collection system for deepwater blowout accidents. The results show that VR-generated data can support the risk analysis of rare events, in the presence of limited data.

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References

Amin, M. T., Khan, F., Ahmed, S., Imtiaz, S. 2021. A data-driven Bayesian network learning method for process fault diagnosis. Process Safety and Environmental Protection 150, 110-122. doi:10.1016/j.psep.2021.04.004

Fan, S., Yang, Z. 2024. Accident data-driven human fatigue analysis in maritime transport using machine learning. Reliability Engineering & System Safety 241, 109675. doi:https://doi.org/10.1016/j.ress.2023.109675

Meng, H., An, X., Xing, J. 2022. A data-driven Bayesian network model integrating physical knowledge for prioritization of risk influencing factors. Process Safety and Environmental Protection 160, 434-449. doi:10.1016/j.psep.2022.02.010

Nhat, D. M., Venkatesan, R., Khan, F. 2020. Data-driven Bayesian network model for early kick detection in industrial drilling process. Process Safety and Environmental Protection 138, 130-138. doi:10.1016/j.psep.2020.03.017

Zhang, F., Qiao, Q., Wang, J., Liu, P. 2022. Data-driven AI emergency planning in process industry. Journal of Loss Prevention in the Process Industries 76, 104740. doi:10.1016/j.jlp.2022.104740