Archives of Occupational Health | Volume 6 | Issue 4 | December 2022 | 1318-20.

Editorial

Machine Learning and Its Application regarding Risk Assessment and Identification in Complex Processes

Saber Moradi Hanifi [*1], Elham Keighobodi [1], Seyed Hosein Tabatabaei [1]

[1] Department of Occupational Health Engineering, School of Public Health, Iran University of Medical Sciences, Tehran, Iran• * Corresponding author: Saber Moradi Hanifi, Email: Saber Moradi22@yahoo.com

Despite the use of various preventive and control measures, accidents still occur in industries. Due to the advancement of technology in industries and their growing complexity, one of the main challenges of safety engineering is to prevent accidents through timely detection of errors and failures in complex systems, as well as using dynamic risk assessment with high efficiency. In recent decades, several models have been presented to predict errors and defects in systems, which are often based on inputs based on public data on human, process and mechanical failure rates, which obviously have high accuracy for use in various industries. Subsequently, the preventive strategies designed based on these results will not be effective in reducing accidents. [1] In industrial processes, there are complex and multifaceted systems that perform multiphase operations characterized by a high level of risk. Evidence-based major accidents which have occurred in process industries worldwide over the past three decades represent losses of billions of dollars. Many of these incidents are catastrophic leading to disruptions in the production process. These incidents have resulted in production loss, property damage, environmental damage, fatalities and injuries. However, the most important issue analyzed is related to major accidents in high-risk industries; it is the lack of robust risk assessment and prudent risk management approaches to identify and assess the risks of major accidents in order to prevent or reduce them from escalating. Accidents caused by work are an integral part of the industry. In addition to physical health, these accidents cause mental health of the individual and also damages to the employers. [2] Although in the analysis of risks, all risks must be stated, usually resource limitations prevent from doing so. For this reason, risk assessment is used. Risk assessment is a systematic and necessary process to determine the impact, occurrence and consequences of human activities on systems with dangerous characteristics. Risk study is conducted with the aim of preventing losses and adverse outcomes of events. [3] Risk is a necessary tool to determine the compliance level of the organization's performance with the organization's safety policy. In

Citation: Moradi Hanifi S, Keighobodi E, Tabatabaei SH. **Machine Learning and Its Application regarding Risk Assessment and Identification in Complex Processes.** Archives of Occupational Health. 2022; 6(4): 1318-20.
Article History: Received: 20 October 2022; Revised: 21 November 2021; Accepted: 01 December 2022

[DOI: 10.18502/aoh.v6i4.11726]

general, risk assessment is a systematic process of identification and comparison focusing on the key tasks of the organization and examining the threats, possibilities and consequences of risks. With the development of artificial intelligence and the emergence of the era of big data, many researchers have used machine learning (ML) methods to conduct extensive research on risk assessment. [4] Organizational risk management plays an important role in the stable performance of financial institutions at country and abroad. Older evaluation methods can no longer meet the needs of users in processing multiple types of data, large number of users, and high-risk prediction accuracy. [5] Many researchers use ML methods. Predictive models for occupational accidents can be based on statistical learning or ML. Due to the large volume of data available, ML replaces the traditional statistical counterpart in predicting future events used in various fields such as engineering, medical sciences, and finance, which provides very useful results. [5] However, a review of existing research shows that ML techniques have not been used much in the analysis of occupational accidents. [6] These methods, based on historical data from event reports, or interviews with employees, ensure their advantages over conventional statistics in terms of predictive performance and the importance of predictors with impact on incident outcomes. [7] The potential benefits of ML can be seen not only from the ability to process large amounts of data, but also through: [1] their ability to deal with large dimensional problems, [2] their flexibility in reproducing the structure of data generation regardless of complexity, and [3] understanding their predictive and interpretive potential through rule extraction. Due to the capability of ML techniques, it has been successfully used in various fields, including the analysis of occupational accidents. [8] The risk assessment model based on ML has gradually emerged in recent years and shows its superiority compared to traditional risk assessment methods. Common modern ML methods include Kervolutional neural network (KNN), support vector machine (SVM), etc. In addition, ML methods based on tree models are widely used in risk assessment. They include decision tree models;and frameworks and integrated models such as Random Forest (RF), GBDT, Extreme Gradient Boosting (XGBoost), and light gradient-boosting machine (LightGBM). [9] Makovsky first used modern ML methods for risk assessment, where credit data was used to build a model on a classification tree to classify good and bad customers. K-Nearest Neighbors (KNN) was also validated more effectively for the two-class classification problem. The artificial neural network model was applied to the personal credit scoring model, which created a scoring system based on user credit data. Experimental results demonstrated that group models such as Random Forest (RF) have a very good performance for risk assessment. Some researchers pointed out that the ML method is mainly modeling historical risk data through supervised learning. After a series of operations such as data processing and feature extraction, the built model was used to predict user behavior and characteristics to determine organizational risk. [10] Therefore, revisiting the issue of risk management through applying artificial intelligence can be a more reliable, adaptable and comprehensive framework for examining the risks in complex industries.

References

1. Kabir S, Papadopoulos Y. Applications of Bayesian networks and Petri nets in safety, reliability, and risk assessments: A review. Safety science. 2019;115:154-75.
2. Zio E. The future of risk assessment. Reliability Engineering & System Safety. 2018;177:176-90.
3. Li J, Reniers G, Cozzani V, Khan F. A bibliometric analysis of peer-reviewed publications on domino effects in the process industry. Journal of Loss Prevention in the Process Industries. 2017;49:103-10.
4. Bhardwaj R, Malik S. Fuzzy reliability evaluation of a fire detector system. International Journal of Computer Applications. 2012; 43(3):41-6.

[DOI: 10.18502/aoh.v6i4.11726]

5. Correa-Jullian C, Groth KM. Data requirements for improving the Quantitative Risk Assessment of liquid hydrogen storage systems. International Journal of Hydrogen Energy. 2022;47(6):4222-35.
6. Abdelgawad M, Fayek AR. Fuzzy reliability analyzer: Quantitative assessment of risk events in the construction industry using fuzzy fault-tree analysis. Journal of Construction Engineering and Management. 2011;137(4):294-302.
7. Hegde J, Rokseth B. Applications of machine learning methods for engineering risk assessment–A review. Safety science. 2020;122: 104492.
8. Paltrinieri N, Comfort L, Reniers G. Learning about risk: Machine learning for risk assessment. Safety science. 2019;118:475-86.
9. Lin S-S, Shen S-L, Zhou A, Xu Y-S. Risk assessment and management of excavation system based on fuzzy set theory and machine learning methods. Automation in Construction. 2021;122:103490.
10. Gajek A, Fabiano B, Laurent A, Jensen N. Process safety education of future employee 4.0 in Industry 4.0. Journal of Loss Prevention in the Process Industries. 2022;75:104691.

[DOI: 10.18502/aoh.v6i4.11726]