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Applications of Fuzzy Hybrid Techniques in Construction Engineering and Management Analysis

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Abstract

Construction engineering and management (CEM) becomes additional advanced with increasing project size and complexness. Numerous fuzzy hybrid techniques are enforced to handle subjective uncertainty and unclearness in CEM issues. The target of this paper is to research applications of fuzzy hybrid techniques across totally different CEM applications (e.g., prediction, higher cognitive process, and optimisation) through a scientific review of 255 journal articles revealed from 2004 to 2021. A list of choice criteria for selecting AN acceptable fuzzy hybrid technique to unravel a particular CEM drawback was conjointly established. This study contributes to the body of data by providing a progressive review of existing fuzzy hybrid techniques used in CEM to (1) demonstrate their capabilities to beat limitations of some normal techniques in determination advanced construction issues, (2) confirm choice criteria for his or her applications, and examine the pertinence of every fuzzy hybrid technique's class to given sensible construction issues.

Keywords: Systematic literature review; Content analysis; Construction engineering and management; Architecture

Introduction

Increased project size and complexness likewise as project delivery risks, conflicting criteria, oft inconsistent needs, and therefore the dynamic nature of construction cause extremely advanced construction engineering and management (CEM) issues involving unclearness, subjectiveness, and uncertainty. to deal with these challenges, researchers have enforced several modeling and computing approaches, like optimisation, machine learning, multi-criteria higher cognitive process (MCDM), and simulation. However, most current applied ways encounter difficulties in handling incomplete information, subjective judgments, and lingually expressed info in sensible construction issues. Construction researchers have used formal logic – a human-like reasoning approach – to tackle these challenges and improve modeling potency. Victimization formal logic alone, however, is proscribed with regard to determination all sides of a CEM drawback. Thus, construction researchers use hybridized formal logic with normal techniques, like MCDM, simulation, optimization, and machine learning, to boost their capabilities in acting dynamic modeling and computing processes. Pairing is outlined because the method of group action 2 or additional techniques to make the most strengths and overcome restrictions of the techniques [1,2]. Therefore, fuzzy hybrid techniques area unit capable of demonstrating skills of the quality techniques and conjointly overcome their limitations.

Current CEM literature shows that utilizing fuzzy hybrid techniques improves modeling capability and effectiveness in addressing CEM issues involving incomplete information, subjective uncertainties, and ambiguity as an example, the pairing of formal logic and optimisation ways will enhance a model's ability to capture each subjective uncertainty and probabilistic uncertainty within the optimisation method. Integration of formal logic with machine learning ways, like artificial neural networks (ANNs), will overcome the latter's limitation in handling lingually expressed info from computer file [3]. The literature conjointly reveals that formal logic has been hybridized with various modeling, computing, and decision-making techniques in construction analysis over the past decades [4,7,10]. Therefore, unremarkably used fuzzy hybrid techniques in construction analysis topics may be classified supported specific sorts

and functions of the applied computing techniques in construction issues, together with optimisation, simulation, machine learning, and MCDM. Consequently, major applications of fuzzy hybrid techniques in CEM analysis may be classified into four categories: fuzzy hybrid machine learning, fuzzy hybrid MCDM, fuzzy hybrid optimisation, and fuzzy hybrid simulation.

Fuzzy hybrid machine learning techniques area unit capable of learning from information and area unit usually used in CEM modeling issues associated with classification and prediction [4]. Fuzzy hybrid MCDM techniques area unit usually accustomed develop call-aid models or systems that may accommodate numerous subjective judgements and lingually expressed info of decision manufacturers [5]. Fuzzy hybrid optimisation techniques area unit usually enforced to unravel multi-objective optimisation issues, like time-cost trade-offs, resource usage, and optimum solutions in CEM analysis. Fuzzy hybrid simulation techniques area unit capable of simulating construction systems (projects or activities), processes, and agents, and that they area unit applied to forecast the behavior of those systems underneath totally different conditions

Discussion

Applications of fuzzy hybrid techniques area unit quickly evolving and wide enforced in a very style of sensible construction issues. However, no elaborate content analysis has been done to demonstrate integrated categorization and itemized applications of fuzzy hybrid techniques for determination specific CEM issues. what is more, this CEM literature conjointly lacks pointers for decisive the pertinence

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of specific fuzzy hybrid techniques to issues among a specific CEM application space. Another analysis gap exists concerning a scientific review of applications of fuzzy hybrid techniques in supporting the choice of advanced technologies (e.g., BIM, GIS, sensors) and handling subjective uncertainty and unity of knowledge in numerous processes of construction comes. to deal with these existing analysis gaps, the objectives of this study area unit to investigate existing and rising applications of fuzzy hybrid techniques in CEM analysis, confirm choice criteria for applications of fuzzy hybrid techniques to unravel CEM issues, and advocate potential enhancements for every fuzzy hybrid class by utilizing the pairing between formal logic and multiple normal techniques and their pertinence to CEM studies that involve advanced technologies in construction, as directions for future analysis.

The rest of this paper is structured as follows. First, an outline of recent applications of formal logic in construction analysis is given. Then, a scientific literature review methodology is bestowed, that uses content analysis to focus on applications of fuzzy hybrid techniques in CEM analysis. this is often followed by the integrated categorization of fuzzy hybrid techniques across totally different CEM application areas together with elaborate discussions of elite papers in every class that demonstrate the capabilities of fuzzy hybrid techniques to unravel advanced CEM issues. Next, the discussion section provides a list for identification and recommendation of choice criteria for applications of fuzzy hybrid techniques to unravel CEM issues. Finally, the last section presents conclusions and attainable future analysis directions concerning potential enhancements of every fuzzy hybrid class and attainable applications of fuzzy hybrid techniques with advanced technologies in construction.

The previous literature review studies offer totally different applications of fuzzy pure mathematics, formal logic, and fuzzy hybrid techniques in numerous CEM application areas. this literature indicates that fuzzy pure mathematics and formal logic may be perpetually applied to tackle advanced construction issues that involve lingually expressed info and subjective uncertainty by victimization acceptable fuzzy membership functions and linguistic variables. In alternative cases, wherever formal logic and fuzzy pure mathematics might not be the simplest work owing to random uncertainty and high dynamism in construction comes, the pairing of formal logic with alternative modeling and computing techniques is usually recommended. Though previous studies provided elaborate investigations into fuzzy hybrid MCDM and NFS in construction management, alternative fuzzy hybrid techniques, like fuzzy optimisation and fuzzy simulation, haven't been investigated very well. to boot, previous studies focused on determination issues among a number of CEM application areas, together with prediction and higher cognitive process. This study aims to increase the review of current construction literature with a close and integrated categorization of fuzzy hybrid techniques in CEM analysis and suggestions for choosing an acceptable fuzzy hybrid technique to unravel issues among a particular CEM application space.

Formal content analysis was accustomed investigate attainable trends and patterns, dominant aspects, and relevant conclusions from applications of fuzzy hybrid techniques in construction issues within the 255 elite papers. Content analysis could be a strong empiric analysis technique for consistently organizing and evaluating the symbolic contents of recorded documents and/or communications (either written or visual) to work out major sides and develop valid inferences from the collected info [6-8]. The leading good thing about content analysis is its ability to accommodate an oversized volume and handle unstructured data which may contains pregnant conceptions of

extracted. Then, fuzzy hybrid techniques were classified into relevant classes supported variety of modeling and computing techniques and year of publication. Next, fuzzy hybrid techniques were matched with specific construction issues they were applied to. Finally, unremarkably used fuzzy hybrid techniques in CEM analysis were known and reviewed very well.

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Conclusion

Content analysis may be qualitative or quantitative, counting on the character of the study. Qualitative content analysis emphasizes decisive which means by grouping information into classes supported interpretation of the contents (e.g., themes, trends, patterns). Quantitative content analysis extends the qualitative approach by generating numerical values for the categorized information (e.g., frequencies, ratings, rankings) and conniving overall frequency of a subject mentioned throughout the complete assortment. This study used each qualitative and mensuration. First, the contents of elite papers, together with application domain, analysis drawback, analysis objective, fuzzy hybrid technique used, reason to pick out the fuzzy hybrid technique(s) if applicable, and (6) dataset accustomed train and judge the fuzzy hybrid technique if applicable, were extracted. Then, fuzzy hybrid techniques were classified into relevant classes supported variety of modeling and computing techniques and year of publication. Next, fuzzy hybrid techniques were matched with specific construction issues they were applied to. Finally, unremarkably used fuzzy hybrid techniques in CEM analysis were known and reviewed very well.

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Conflict of Interest

None

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