Lecture Notes in Networks and Systems 1446

Nenad Filipović *Editor*

Applied Artificial Intelligence 4: Medicine, Biology, Chemistry, Financial, Games, Engineering

The Third Serbian International Conference on Applied Artificial Intelligence (SICAAI)

Springer

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ISSN 2367-3370 ISSN 2367-3389 (electronic)
Lecture Notes in Networks and Systems
ISBN 978-3-031-99200-1 ISBN 978-3-031-99201-8 (eBook)
https://doi.org/10.1007/978-3-031-99201-8

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents

Community Event Discovery Using 'X' Data Stream

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Abstract. In recent years, significant research has been carried out to discover current events and the number of events from X's data stream and to reveal the contextual dimension of events. One of the major challenges in this context is that most traditional methods have to estimate the number of events in order to contextually analyze events. Another problem is that some methods tend to detect events that often trigger a significant volume of communication. In this study, we propose a community-based event discovery system that reveals events by applying community detection on the graph representing the co-occurrence relations of n-grams that are frequently observed in X's posts. We evaluate the effectiveness of the proposed system over a dataset used as a comparative dataset. Our system shows the success of discovering as many events as the number of existing events in an unsupervised manner. It also represents each event with words and multiple-word distributions, helping to analyze the subject of events contextually.

Keywords: Community detection · event detection · event discovery · N-gram · X · Twitter

1 Introduction

Social media is a new media system that enables individuals to communicate and share information on the internet. It is a system that has managed to spread rapidly, thanks to its availability at any place and time. In social media, people can share content and easily access the content they are looking for. One of the most popular social media applications is 'X' formally Twitter. 'X' is an online social networking site which is used for connecting people and allowing the people to share their thoughts on different issues using short messages called tweets. Today, 'X' has been a major source of news, which covered both major and minor events. Currently, X has over a billion users worldwide. In a recent survey conducted by Hasan et al. [1], it was presented that people are more

N. Filipović (Ed.): AAI 2024, LNNS 1446, pp. 1–8, 2025.
https://doi.org/10.1007/978-3-031-99201-8_1

dependent on X as their main source of news compared to Facebook, Google + and other sources of news. Today, politicians, businesspeople, journalists, youths and all categories of people use X for different purposes, such as advertising, politics and weather forecast. For instance, X tends to be a tool used by most journalist to spread news quickly than the traditional media because X does not only serve as a socializing outlet but also an avenue of expressing personal opinions about any real-world event. In recent years, journalists and media outlet use X to spread news to the public. A recent survey conducted by Pew Research Center [2] shows that 59% of Americans get news regularly from X, 31% from Facebook and the other media platform is less than 10%. This makes X the most used social media platform in 2021. After comparing X with other social media platforms, the research shows that X has outpaces all other social media sites when it comes to obtaining news.

Tweet data is very short text due to the 140-character limit. This creates difficulties for many applications such as text classification, sentiment analysis, and event discovery implemented on the X dataset because the data is often sparse and has an irregular format because of a wide variety of tags attached to tweets. Moreover, there exist other challenges for many pre-processing and feature extraction methods due to the volume of data from X, which generates over 340 million tweets per day [3]. Given the volume and diversity of data, extracting useful information from it can be a time-consuming task to easily enable users to discover key events shared on X. Feature extraction and categorization is also another main challenge when it comes to event detection. Extracting the right set of features is important in event discovery because it helps in representing the event and capturing the most valuable information. Revealing the dependency between selected attributes is crucial to represent events with a set of meaningful attributes. It is important to represent events with a set of meaningful and distinctive attributes to reveal the dependency between the selected attributes.

2 Related Works

Many works have been presented for event discovery on social media, most especially on social network like X. Over the years, researchers have developed different methods in discovering both major and minor events in media stream. These approaches are generally classified as term weighting-based methods, Topic modelling-based methods and clustering-based methods.

2.1 Term Weighting Based Methods

Term weighting-based method is a supervised method that assigns appropriate weights to each term observed in all documents in order to enhance the performance of text classification. Term weighting-based event detection methods generally aim to group the high frequency terms which co-occur in large number of tweets. However, describing a complex event using individual words is difficult and insufficient because of the ambiguity it holds due to the lack of context [4]. One of the methods using the term frequency is Mention-Anomaly-based Event Detection (MABED) method which is statistical method which relies on tweets. The method calculates the frequency of dynamic mentions (links)

that users use in tweets in order to detect important events and to understand their impact on the crowd [5]. In addition, MABED provides dynamic event discovery and dynamically predicts the time intervals in which events occur. Alvanaki et al. [6], presented En Blogue method for Web 2.0 Streams to detect emergent topics. It focuses on identifying topics that occur in a certain time period on blogs and X social network through the statistical values of tag pairs and correlations between them. Gaglio et al. [7] presented X Live Detection Framework (TLDF) that uses Soft Frequent Pattern Mining (SFPM) algorithm to identify specific topics in a macro event of a X data stream. TLDF uses a dynamic temporal window to detect real-time events based on term associations. TLDF utilizes applicable mechanisms for reducing the number of terms to be considered, such as the term selection method by applying SFPM for generating top-k terms from the set of tweets.

In addition to the TLD, other implementations of term weighting-based methods have been developed, such as the X Monitor [8], Tweet Info [9], Trending Score [10]. All these methods aim to discover discriminative keywords and keyword pairs within a specific time window. The various implementations may differ on the term selection methods that they employ which ultimately affect the variations in the tracking and computation of term correlations.

2.2 Topic Modeling Based Methods

Topic-modelling-based methods focus on extracting latent word distributions of latent events. The general approach is that tweets are represented as a multinomial distribution over the latent events, and each event is characterized by a distribution of the terms contained in those tweets. Tweets consist of different topics and for each topic, they have a probability distribution over the terms in contained [1]. Some well-known topic models such as Latent Dirichlet Allocation (LDA) and Latent Semantic Analysis (LSA) have been used for discovering events on social media. LDA is the most used probabilistic topic model [11]. LDA is an unsupervised approach to finding groups of words called "topics" in a corpus. These topics are made up of words that often occur together and often share a common theme. Therefore, these topics with a predefined set of words can be used as phrases to best describe the entire document. LDA reveals latent word distributions using a Dirichlet process. The other popular model is known as Latent Semantic Analysis (LSA) that extracts word distributions of topics from documents. Differently from LDA, LSA converts the texts into word-topic and document-topic matrices. After then, it applies truncated singular value decomposition. However, capturing good topics from a tweet can be problematic due to the limitation placed on the length of tweets. For event discovery in social media, there exist some methods developed based on these topic models. One of the most popular implementations known as TopicSketch was carried in [12]. The method models the entire tweet stream as a mixture of multiple latent streams and identifies the top k hidden topics whose ratio is greater than a predefined threshold in order to detect bursty events based on an acceleration on the X stream. Latent Semantic Analysis (LSA)-based sound event detection system was presented in [13] by taking the co-occurrence of events which is represented as the degree of their overlapping in a fixed length. The events are clustered using K-means and an observation matrix that is decomposed by using the singular value decomposition.

2.3 Clustering Based Methods

Clustering based methods are unsupervised methods which take a series of objects such as tweets, then organize or group them based on their similarity to find clusters [14]. Clustering-based methods for event discovery can use incremental clustering (partitional clustering algorithm) approaches or community detection algorithms [15] presented ReDites system which discover events related to security domain such as violence, terrorism, and natural disasters.

3 Method and Material

In this chapter, we provide a detail description about our proposed method within the framework of our research. We propose a community-based event discovery system that discover events by applying community detection on the graph representing the co-occurrence relations of n-grams that are frequently observe in X posts. Figure 1 demonstrates the main steps of the proposed method. We firstly created our corpus after having access to X data stream using X API. We downloaded the tweets about different events and pre-processed them. After creating our dataset, we extracted the n-grams, constructed co-occurrence word graph, applied community detection algorithm to detect events and obtained word distributions of the events.

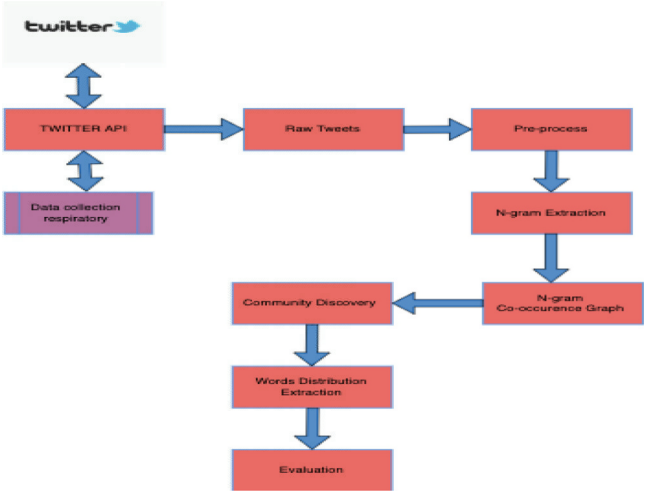

Fig. 1. The illustration of our proposed model

3.1 Creating Corpus

We created our dataset *D* using tweets ID from the popular X 2012 corpus which contains tweets IDs of different events that were collected between the years 2012 to 2016. This

corpus consists of 30 different events which are associated with real world events such as "Ebola" in west Africa, "Brexit" which happened in the UK, "US election". These IDs are only intended for academic purposes and the tweets are downloaded using X API. X API is an application interface that allows access to X in a unique and advance way. Some functions of X API include, sorting, viewing, retrieving and filtering of data on X. For example, a user can create a personal project to observe the sentiment of his own tweets. Build an application which can retrieve user location information of tweets. Users can also filter different events base on their importance.

3.2 Pre-processing Step

In pre-processing step, we cleaned our dataset by removing special characters, numbers, emoji, url link and any other unnecessary character in our dataset. Since our corpus D is obtained from X, there were many unnecessary characters from the tweets. Though some words that were not in the NLTK dictionary (written in English) were deleted while some words that are relevant to our research like "Ebola" were preserved in order to obtain a better performance and to deal with sensitivity.

3.3 Community Detection Process

After constructing our graph structure, we applied Louvain algorithm in order to discover events in our corpus. Louvain algorithm is a greedy algorithm which works in an iterative manner, capable of having a series of community hierarchy. Louvain algorithm shows that every clustering steps of nodes are reduced by a single node which belong to same cluster (Lu et al., 2015). This is an unsupervised algorithm which is divided into two phases namely Modularity Optimization and Community Aggregation. These two steps are repeated until there are no more changes left in the network and the main aim is to achieve a maximum modularity.

Modularity is a measure of the structure of a graph within a community. Modularity optimization is a method used to detect communities in each graph based on their modularity scores. The Maximum modularity quantifies the quality of obtained communities. The formula for calculating modularity optimization is given below:

$$M = \frac{1}{2m}\sum\nolimits_{i,j}(A_{ij} - P_{ij})\delta(c_i, c_j) = \frac{1}{2m}\sum\nolimits_{i,j}(A_{ij} - \frac{k_i k_j}{2m})\delta(c_i, c_j) \tag{1}$$

where, A_{ij} is the adjacency matrix which represents the weight of the edge connecting the two nodes i and j, k_i represents the degree of the node i, c_i refers to the community of node i. If c_i and c_j are same, $\delta-$ function $\delta(u, v)$ outputs 1 and 0 otherwise. m corresponds to the number of the edges in the graph [16].

Louvain algorithm firstly assigns each node to its own community. Each node is removed from its own community and moved to the community of each neighbor of this node. Then, the modularity is calculated and the new communities are obtained based on the highest modularity increase. This process is repeated for all nodes until an increase in the modularity value is not achieved.

The next step after completing modularity optimization is community aggregation. Here all the nodes which belongs to the same community are merged into a single big

node. The links which connect the big nodes are the sum of the ones from the previously connected nodes from the same different communities. This step generates self-loops which are the sum of all the links inside a given community before they are merged into one node (Fig. 2).

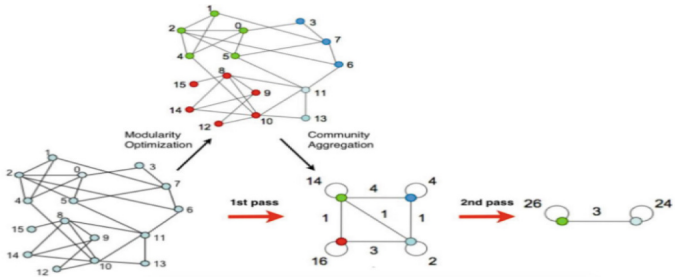

Fig. 2. The illustration of Louvain algorithm (Blondel et al. 2008)

Figure 3 shows the main steps of Louvain algorithm. We apply Louvain algorithm to our n-gram co-occurrence graph to detect communities. Each community refers to one event in our system.

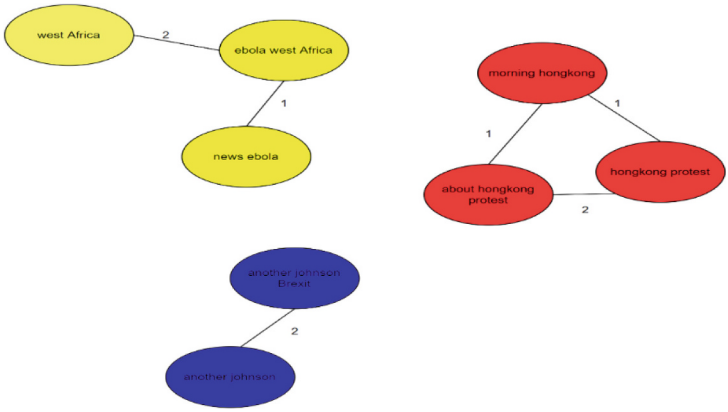

Fig. 3. The obtained communities after applying Louvain algorithm on n-gram co-occurrence graph

The above figure explains how louvain algorithm is used to detect three different events which are represented in a colorful way. These three events are Ebola, Hongkong protest and Brexit.

3.4 Extracting Word Distribution of Events

After community detection process, we extract the word distributions describing contextually these events. Each community obtained by the Louvain algorithm contains

different n-grams. Each word that occurs in the n-grams observed in a community is listed. A word can be observed in more than one n-gram. In this community, the frequency of how many n-grams this word appears is calculated. The frequency value calculated for each word is normalized by dividing the total frequency value. This value represents the probability that a word belongs to this community. In other words, we calculate the probability of each word observed in each event.

4 Discussion and Results

4.1 Dataset

This research is carried out using the X Event 2012 dataset. It is a collection of 30 different real-world events that were discussed and collected from X from the years 2012 to 2016 using the X API. This dataset is strictly for non-commercial purposes. Table 1 shows the classes (tags) of 30 different events that occurred between 2012 and 2016 (Fig. 4).

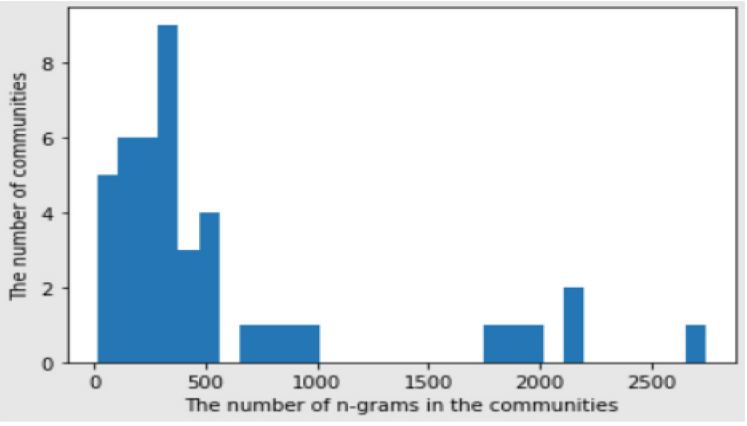

Fig. 4. The distribution of communities produced by community detection algorithm for the dataset consisting of six events.

The distribution of the words included in the six communities is presented in Table 4. In this experiment, the events were "Hongkong Protests", "Ebola", "Hurricane Sandy", "Euro 2012", "Ferguson" and "Obama-Romney". The word distributions in the obtained communities were examined and compared with the selected real event classes. As a result, it is observed that the six selected communities were discovered correctly.

5 Conclusion and Implications

We propose an event discovery system on X using n-gram based graph structure and community detection algorithm. One of the major challenges in event discovery is that most traditional methods have to estimate the number of events in order to be able to

contextually analyze events. Another problem is that some methods tend to detect events that often trigger a significant volume of communication. Our proposed method discovers the events in an unsupervised manner. Moreover, it also has the ability to reveal events that do not trigger much interaction compared to other events. Our proposed method shows a very promising performance on unbalanced datasets compared to the previous methods.

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Advanced Risk Management Practices - The Application of the Exact Solutions Methods for Resilience Factors Improvement

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Abstract. In the context of organizational resilience, branch and bound algorithms can be leveraged to determine the most suitable management techniques from a set of options, considering factors such as cost and time constraints. This paper presents a novel approach for assessing the suitability of methods aimed at improving organizational Resilience Factors (RFs). The proposed algorithm integrates fuzzy logic and exact solutions methods. The algorithm comprises several steps, including fuzzy rating of method suitability, determination of aggregate suitability values, and assessment of method application costs. Furthermore, a multidimensional optimization problem is formulated to maximize the overall effectiveness of selected methods while considering budgetary constraints. To efficiently navigate the solution space and identify near-optimal solutions, a Branch and Bound algorithm is employed. The proposed framework offers a comprehensive methodology for decision-makers to make informed choices regarding method selection and resource allocation for business process improvement initiatives. Experimental results demonstrate the efficacy and practical applicability of the proposed approach in real-world scenarios.

Keywords: Resilience Factors · Optimization · Branch and Bound

1 Introduction

In today's rapidly changing and uncertain business landscape, the ability of organizations to adapt and thrive in the face of adversity is paramount. This ability, often referred to as organizational resilience, encompasses the capacity to anticipate, respond to, and recover from disruptive events while maintaining core functions and preserving essential services [1]. As organizations seek to enhance their resilience in the face of complex challenges, the application of innovative methodologies becomes increasingly crucial [2].

This paper explores the potential of branch and bound method application as a novel approach to enhancing organizational RFs. Branch and bound algorithm, as a class of optimization techniques, offers a systematic and efficient way to explore solution spaces and identify optimal or near-optimal solutions [3]. While traditionally applied in fields such as operations research and computer science, their application in the realm of organizational resilience remains relatively unexplored.

N. Filipović (Ed.): AAI 2024, LNNS 1446, pp. 9–16, 2025.
https://doi.org/10.1007/978-3-031-99201-8_2

The primary objective of this paper is to bridge this gap by investigating how branch and bound algorithms can be leveraged to strengthen organizational resilience. As organizational RFs can be identified and assessed [4], the main objective of this research is to propose a model to improve RFs which are denoted as the weakest link in the system of organizational resilience. By integrating principles of optimization with established theories of resilience, we aim to provide insights into how organizations can effectively navigate uncertainty and build adaptive capacity.

While there is a wealth of literature on organizational resilience and exact optimization methods independently, there is a notable lack of research at the intersection of these two domains. Existing studies have primarily focused on traditional approaches to resilience enhancement, such as risk management strategies and organizational learning processes, overlooking the potential of advanced optimization methods [5]. Furthermore, the few studies that have examined the application of exact optimization methods or metaheuristic methods in organizational resilience have often been theoretical, lacking empirical validation and practical insights [6].

By exploring the intersection of optimization executed by exact optimization methods and organizational resilience, this paper aims to contribute to a deeper understanding of how organizations can effectively navigate uncertainty and build sustainable competitive advantage in today's dynamic business environment. For the optimized enhancement of identified RFs, the branch and bound algorithm is employed.

The paper is structured to include five sections. Section 2 contains the literature review where organizational resilience and exact optimization methods are mainly discussed, while Sect. 3 is used to present the theoretical framework and methodology. Section 4 presents a case study with a discussion of the obtained results, and Sect. 5 provides the conclusion of the research.

2 Literature Review

Organizational resilience has garnered increasing attention in the literature as organizations grapple with the challenges posed by globalization, technological advancements, and environmental uncertainty. Researchers have defined organizational resilience as the ability of an organization to anticipate, respond to, and recover from disruptions while maintaining core functions and adapting to changing circumstances [7]. Various theoretical frameworks have been proposed to conceptualize and measure organizational resilience, including the Dynamic Capabilities Perspective [8], or the Resilience Engineering Framework [9]. The research presented in this paper relies on the RFs fuzzy Delphi assessment [10].

Branch and bound algorithms, a class of optimization algorithms, are particularly well-suited for solving combinatorial optimization problems by systematically exploring solution spaces and pruning suboptimal branches [11]. While branch and bound algorithms have primarily been applied in operations research, computer science, and engineering [12], their potential application in enhancing organizational resilience remains underexplored [13]. It is worth mentioning that the branch and bound algorithms are widely applied in management specifically for the Allocation of Business Model Components while analyzing different business models [14].

Few studies have explored the application of exact optimization methods or heuristic optimization algorithms to enhance organizational resilience [15]. Specifically, the branch and bound algorithms are employed only for resilient path selection in networks [16]. This gap presents a significant opportunity for researchers to leverage the exact solutions methods and heuristic optimization techniques to address the complex and dynamic nature of organizational resilience. The literature review highlights the significance of organizational resilience in today's business environment and the potential of exact solutions methods and heuristic optimization techniques, to enhance RFs. By integrating insights from both domains, this paper seeks to contribute to a deeper understanding of how organizations can effectively navigate uncertainty and build adaptive capacity.

3 Theoretical Framework and Methodology

It might seem obvious that organizations need to develop a resilience capacity to overcome different impacts and to continue successful business operations, in other words, to handle unexpected events, bounce back from Key Performance Indices downfall, and even improve future success [17]. This paper sets the model for optimized enhancement of the RFs considering different constraints.

Organizational resilience is often characterized by a set of interrelated factors that enable organizations to effectively anticipate, respond to, and recover from disruptions. Generally, RFs may be presented through a set of indices $\{1, .., J, .., J\}$. The total number of RFs is denoted as J and $j, j = 1, .., J$ is an index of RF. Drawing on existing literature [10], we identify three key RFs that are particularly critical for organizational success: (1) Redundancy, (2) Self-organization, and (3) Awareness.

To enhance the three key RFs – RF1 - Redundancy, RF2 - Self-organization, and RF3 - Awareness – this study proposes the methodology with the following steps:

Identification of Management Techniques:
The set of methods that could be used for the RFs' enhancement should be identified by drawing on existing literature [18] and expert consultation. For the presented research, the total number of the methods that can be applied for enhancement RF $j, j = 1, .., J$ is denoted as M_j and $m, m = 1, .., M_j$ is an index of methods.

Assessment of the Management Techniques Suitability:
Each treated RF can be enhanced by executing one or several techniques for analysis and improvements [18]. It is assumed that the Operations Manager has chosen the set of methods at the level of each RF that can be applied to enhance the treated RF. In the general case, the methods are presented as a set $\{1, .., m, .., M_j\}$.

The method suitability $m, m = 1, .., M_j$ for the improvement of RF $j, j = 1, .., M$ is stated as a fuzzy group decision-making problem, so the group of three Decision Makers (DMs) is in charge of the assessment. Formally, DMs that participate in the assessment are denoted by a set $\{1, .., e, .., E\}$. The total number of DMs is denoted as E. The index of DM is noted as $e, e = 1, ., E$. In this manuscript, DMs are: Chief Executive Officer $e = 1$; Operations Manager $e = 2$; Management System Manager $e = 3$. As is well known, it is closer to the human way of thinking that assessments are expressed

using linguistic terms than precise numbers of some measurement scales. The fuzzy sets theory [19, 20] presents an appropriate mathematical tool that provides an opportunity to present words of natural language in a quantitative manner.

In this manuscript, the method suitability for the improvement of RFs is described by pre-defined linguistic expressions which are modeled by fuzzy numbers. The main features are membership function, granularity, and the domain.

In the literature, a large number of authors suggest the use of Triangular Fuzzy Numbers (TFNs) for modeling uncertainties and imprecise [18]. They form their opinion on the fact that TFNs do not require complex mathematical calculations and at the same time capture the uncertainties of natural language in a sufficiently good way.

In works that can be found in the literature, the granulation is most often determined based on the subjective assessment of DMs respecting the size and complexity of the problem. The theoretical insight [22] suggests that DMs can use a maximum of seven linguistic expressions, as in [23] and this research. These pre-defined linguistic expressions and their corresponding TFNs are presented:

extremely low applicability -(1,1, 2.5)
very low applicability -(1,2, 3)
low applicability -(2,3.5,5)
medium applicability -(3.5,5, 6.5)
high applicability -(5,6.5,8)
high applicability -(7,8, 9)
extremely high applicability -(7.5,9, 9)

Domains of the defined TFNs are defined on a common measurement scale [24]. A value of 1 indicates that the applicability of the method is almost negligible. On the other hand, a value of seven indicates that the suitability of the method certainly leads to the improvement of RFs.

Improving the resilience of a company can be achieved through simultaneously improving the value of considered RFs. It is assumed that each RF can be improved at least by applying one or more predetermined methods. Within the introduced assumptions, the problem of selection of improvement methods is stated as a multidimensional knapsack problem with mixed max/min constraints.

Cost and Time Evaluation:
Besides the assessment of the management technique's suitability, there is a task to assess the costs and time needed for the execution of the method. The estimates for each management technique are based on empirical data or expert judgment. Of course, this task is intended to be executed by the operations manager.

Formulation of Optimization Problem:
This step implies the definition of the optimization problem as selecting the subset of management techniques that maximize resilience enhancement while minimizing total costs and time required for implementation, subject to budget constraints. The proposed algorithm is further explained.

The Proposed Algorithm:
The proposed Algorithm can be realized through the steps which are further presented.

Step 1. Fuzzy rating of method suitability $m, m = 1, .., M_j$ for the enhancement of RF $j, j = 1, .., J$ at the level of DM $e, e = 1, .., E$ is described by one of the pre-defined linguistic expressions and modeled by TFN $\tilde{x}^e_{jm}$:

where:

$$\tilde{x}^e_{jm} = \left(a^e_{jm}, b^e_{jm}, c^e_{jm}\right) \tag{1}$$

Step 2. Let us determine the aggregate value of the method suitability $m, m = 1, .., M_j$ at the level of each RF $j, j = 1, \ldots, J$ by applying the fuzzy geometric mean operator, $\tilde{x}_{jm}$:

$$\tilde{x}_{jm} = \left(\sqrt[E]{\prod_{e=1,..,E} a^e_{jm}}, \sqrt[E]{\prod_{e=1,..,E} b^e_{jm}}, \sqrt[E]{\prod_{e=1,..,E} c^e_{jm}}\right) = \left(a_{jm}, b_{jm}, c_{jm}\right) \tag{2}$$

Step 3. Representative scalar TFN $\tilde{x}_{jm}, x_{jm}$, is obtained by applying the center gravity method [25], so that:

$$x_{jm} = a_{jm} + \frac{c_{jm} - a_{jm} + b_{jm} - a_{jm}}{3} \tag{3}$$

Step 4. The assessment of cost for each technique application $\gamma_m, m = 1, .., M$ is performed by Operations Manager. This person bases the assessments on experience, evidence data as well as the results of the best practice.

Step 5. A multidimensional KP problem with max/min constraints is presented:

Fitness function:

$$\max_{m=1,..,M} x_{jm} \tag{4}$$

Subject to:

$$\sum_{m=1,..,M} \gamma_m \leq \mathcal{G} \tag{5}$$

where $\mathcal{G}$ the total available budget for the improvement of RFs during one business year.

Application of Branch and Bound Algorithm:
In the end, a branch and bound algorithm is implemented to systematically explore the solution space and to identify the optimal or near-optimal solution.

4 The Case Study

A case study is implemented in a complex international company that produces high-tech equipment for quality management in different industries. The team of DMs has been appointed in compliance with the research guidelines. They had several meetings to provide an assessment of the methods' suitability for the RFs enhancement. The operations manager has provided an assessment in terms of the costs and time needed for the execution of the method.

The proposed Algorithm (Step 1 to Step 3) is illustrated for method $m = 9$ for RF ($j = 1$). The DMs have assessed the suitability of the method $m = 9$ for the enhancement of RF $m = 9$ as follows:

$$L3, L5, L4 \tag{6}$$

The aggregated value is obtained by the application of fuzzy cubic mean:

$$\tilde{x}_{19} = \left(\sqrt[3]{\frac{1}{3} \cdot (2^3 + 5^3 + 3.5^3)}, \sqrt[3]{\frac{1}{3} \cdot \sum_{e=1,\ldots,E} (3.5^3 + 6.5^3 + 5^3)}, \sqrt[3]{\frac{1}{3} \cdot (5^3 + 8^3 + 6.5^3)} \right) = (3.88, 5.28, 6.72) \tag{7}$$

The representative scalar TFN, $\tilde{x}_{19}$ is obtained by the application of the center of gravity defuzzification method:

$$x_{19} = 3.88 + \frac{6.72 - 3.88 + 5.28 - 3.88}{3} = 5.30 \tag{8}$$

Similar calculations will provide the crisp values of the suitability of the method whose execution should enhance identified RFs.

By applying the adequate software solution that integrates the branch and bound algorithm execution [26], we obtain the optimal set of methods that need to be executed for the RFs enhancement in the treated company. The optimal solution is found by the software execution in the 23rd iteration after 0,041872 s.

The methods to be applied to enhance each of the three observed RFs are given in Table 1.

Table 1. The Optimal Set of Methods.

The Treated RFs	RF ($j = 1$)	RF ($j = 2$)	RF ($j = 3$)
The Optimal Set of Methods	$m = 2$; $m = 6$; $m = 20$; $m = 21$; $m = 23$; $m = 24$	$m = 3$; $m = 5$; $m = 6$; $m = 9$; $m = 14$; $m = 16$; $m = 2$; $m = 6$; $m = 20$; $m = 21$; $m = 24$	$m = 3$; $m = 6$; $m = 9$; $m = 20$; $m = 21$; $m = 23$

Taking into account the information provided by Table 1, it may be concluded that methods that should be executed in the first place, are those which are common for every RF. Namely, those are generic flowcharts, brainstorming, and brain writing techniques. After that, the methods that could improve at least two RFs that should be applied until the defined budget is met are balanced scorecards, generic checklists, mind maps, 5W2H, and importance-performance analysis. Finally, relations diagrams could be defined and/or generic tables.

5 Conclusions

In this paper, the theoretical foundation for the study is established, outlining the principles of organizational resilience and branch and bound algorithms, and exploring their potential synergy. The research is described including the implementation of branch and bound algorithms within an organizational context and the steps involved in enhancing resilience factors.

A case study is presented illustrating the application of branch and bound heuristics to enhance organizational RFs, providing real-world insights into the efficacy of this approach. The results indicate the order of management methods that should be executed to enhance organizational RFs most effectively. The chosen tools for the improvement of RFs are mainly generic in nature so their application may have a wide range of benefits. Taking into account the budget for the overall RFs improvement, it is considered that their execution will improve overall business performance and prepare for different disruptions.

The main constraints of the presented research are the following. The structured methodology demands several DMs that are highly skilled, simultaneously holding appropriate business administrative positions to provide the input data. This part of the algorithm execution is the most sensitive one since low-skilled managers may bring wrong input data. The determination of the budget intended for the RFs improvement can also be difficult to perform.

Future research should be scoped to the conducting of case studies in similar organizations so appropriate statistical tests could be conducted followed by appropriate conclusions. Also, heuristic algorithms and meta-heuristic algorithms could be applied to obtain the solution of methods that could be applied for the RFs enhancement. This would leave space for further comparisons and discussions.

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Efficient Sequential Detection: Enhancing Cancer Detection in Sequential MRI Sequences

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Abstract. Conventional object detection models are typically trained to detect objects in images devoid of sequential correlation. However, in the context of MRI imaging, where data is inherently sequential, valuable information lies within the adjacent slices for cancer detection. While 3D Neural Networks present a logical avenue to exploit this sequential nature, their high parameter counts, and complex training dynamics pose significant challenges. Additionally, mutual attention mechanisms, although effective, often require a large volume of training data, which may not always be readily available in medical settings. In response to these challenges, our proposed method efficiently harnesses sequential characteristics of MRI data by integrating information from preceding, current, and succeeding slices. Notably, this integration is strategically incorporated into specific segments of the network architecture to optimize performance. We provide empiric results and give practical advice for using our method with existing architectures. By seamlessly integrating this approach into the YOLOv5 framework, we achieved a notable 2.8% enhancement in the mean Average Precision (mAP).

Keywords: object detection · sequential data · YOLOv5 · brain cancer · MRI

1 Introduction

Brain cancer is among the most devastating and life-threatening diseases, often presenting significant challenges to both patients and healthcare providers. The urgency of early detection cannot be overstated, as timely intervention significantly impacts treatment outcomes and patient survival rates. Magnetic Resonance Imaging (MRI) stands as a cornerstone technique in the diagnosis of brain cancer, offering unparalleled insights into the intricate structures of the brain with high resolution and non-invasiveness. However, despite the utility of MRI in diagnosing brain cancer, its detection remains a complex and nuanced endeavor, and the shortage of experienced radiologists further compounds the issue, as an accurate interpretation of MRI scans demands specialized expertise and time-intensive analysis.

In recent years, the advent of deep learning has revolutionized medical image analysis, offering a promising avenue for automated and expedited brain cancer detection [1]. Deep learning models can efficiently sift through vast amounts of imaging data, swiftly

N. Filipović (Ed.): AAI 2024, LNNS 1446, pp. 17–24, 2025.
https://doi.org/10.1007/978-3-031-99201-8_3

The paper [33] proposes a robust generalized dynamic inversion (GDI) control system design with adaptive neural network (NN) estimation for spacecraft attitude tracking in absence of knowledge of the spacecraft inertia parameters. The robust GDI control system works to enforce attitude tracking, and the adaptive NN augmentation compensates for the lack of knowledge of the spacecraft inertia parameters. Neural network-based active control is applied to a model with external disturbance with bounded input in [34]. The article [35] presents a finite-time prescribed performance (FTPP) control approach based on a learning Chebyshev neural network (LCNN) for spacecraft attitude tracking with modeling uncertainties, actuator faults, and external disturbances. Spacecrafts can be controlled and measured with a novel inertial device called a VSMSCSG. An effort to improve attitude measurement and control accuracy of the spacecraft is made in [36]. A spacecraft attitude measurement and control method based on variable speed magnetically suspended control sensitive gyroscopes (VSMSCSGs) and the fractional-order zeroing neural network (FO-ZNN) steering law is proposed.

4 Conclusions

The article provides an attitude control model and reviews methods, which are used to eliminate the effects on the SC, including disturbances, noises and uncertainties. We tried to overview different approaches in recent papers that consider uncertainties in the model of SC orbital motion with the goal of subsequently creating a control algorithm that takes into account the maximum number of inaccuracies. It is important for achieving accurate orientation control. AI methods applied to the SC orbital motion control were briefly reviewed. There are almost no methods in the literature for using randomized algorithms to reduce errors associated with unknown-but-bounded disturbances, noise and uncertainties. In the future, we plan to demonstrate AI methods associated with randomized algorithms that can help to significantly improve the quality of satellite attitude stabilization and compare them with modern AI ones.

Acknowledgment. The research was carried out at Saint Petersburg University and supported by RSF (project No. 24-41-02031, https://rscf.ru/project/24-41-02031/).

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N. Filipović (Ed.): AAI 2024, LNNS 1446, pp. 429–430, 2025.
https://doi.org/10.1007/978-3-031-99201-8