Scholar Publishing Group
Frontiers in Ocean Engineering
https://doi.org/10.38007/FOE.2020.010402
ISSN 2790-2706 Vol. 1, Issue 4: 9-17

Safety Research of Floating Oil Drum System in Offshore Engineering Based on Dynamic Programming Algorithm

Essimbi David*

Univ Rennes, INRIA, CNRS, IRISA, Rennes, France

**corresponding author*

Keywords: Based on Dynamic Programming Algorithm, Ocean Engineering, Floating Oil Drum System, Safety and Efficiency

Abstract: With the rapid improvement of science and technology and the continuous improvement of productivity levels, the disadvantages of manual work in various industries are becoming more and more obvious. People pay more and more attention to how to reduce labor intensity and improve the degree of automation of equipment. The safety of floating oil drum system in marine engineering is beneficial to improve the utilization rate of marine resources. The purpose of this paper is to study the safety of floating oil barrel system in marine engineering based on dynamic programming algorithm. In the experiment, based on the content of the system test and experiment, the dynamic programming algorithm is used to investigate and analyze the safety and efficiency of the dynamic programming algorithm in the floating oil barrel system in marine engineering.

1. Introduction

Dynamic programming algorithms are commonly used in applications in various fields of science, such as bioinformatics, mathematics, computer science, and economics. However, with the increase of the amount of computing data, the time cost of ordinary scientific computing has become unbearable, and more powerful computing methods must be used to meet the needs [1]. Therefore, realizing the parallelization of dynamic programming problems has become a research problem of more and more scientists and scholars. Compared with other problems, the main feature of the dynamic programming algorithm is that the data dependence is stronger, so the difficulty of parallelization is higher, and it is not very easy to achieve efficient parallelization.

The dynamic programming algorithm is an exact algorithm, which can theoretically obtain the optimal solution of complex optimization problems. Richard C studied the Norwegian company's announcement that Equinor is considering powering an 88MW offshore floating wind farm for

Copyright: © 2020 by the authors. This is an Open Access article distributed under the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (https://creativecommons.org/licenses/by/4.0/).

platforms at two oil and gas fields. The state-owned energy company's proposed 11-turbine Hywind Tampen project will power platforms at the Snorre and Gullfaks fields in the Norwegian North Sea. It claims this could open up new opportunities to reduce carbon dioxide emissions by more than 200,000 tonnes per year. Equinor added that this could be the first time an offshore wind farm is directly connected to an oil and gas platform [2]. Pengle studies on the vehicle routing problem, which is a typical combinatorial optimization problem, and mainly focuses on the case of a certain vehicle loading capacity. In fact, the loading capacity of a vehicle often varies with the type of vehicle, the size of the cargo, and customer requirements. Therefore, the variable-capacity vehicle routing problem is introduced, and a fast dynamic programming algorithm based on the K-step best-fit decrement and minimum spanning tree method is proposed, which can be used as an approximate decoupling between the cargo packing problem and the cargo packing problem. The router selection problem in the variable-capacity vehicle routing problem. In addition, the theoretical analysis of vehicle travel upper limit and local minimization based on the short-path priority principle is also carried out. Finally, taking the logistics transportation task of different capacity vehicles as an example, the quality and performance analysis are carried out under different parameters and scales to illustrate the feasibility and advantages of the proposed algorithm [3]. The dynamic programming algorithm is an optimization method in the decision-making process by decomposing the problem into several sub-problems and solving them in sequence.

This paper studies the overview of dynamic programming algorithm, including dynamic programming algorithm and application; design and method of safety evaluation of floating oil drum system; application status of automatic production line technology in floating oil drum processing, including floating oil drum Analysis of the overall structure of the processing system automated production line and production line. In the experiment, based on the content of the system test and experiment, the dynamic programming algorithm is used to investigate and analyze the safety and efficiency of the dynamic programming algorithm in the floating oil barrel system in marine engineering.

2. Research on Floating Oil Drum System in Ocean Engineering Based on Dynamic Programming Algorithm

2.1. Overview of Dynamic Programming Algorithms

(1) Dynamic programming algorithm

The dynamic programming algorithm has a kind of activity process. Due to its particularity, the process can be divided into several interconnected stages, and decisions must be made in each stage, so that the whole process can achieve the best activity effect. Considering a problem as a multi-stage process with a chain-like structure, it is called a multi-stage decision process [4-5].

(2) Application of dynamic programming algorithm

Dynamic programming algorithms are widely used [6]. The representative studies are as follows: The single-machine scheduling problem with deteriorating effect is studied with minimizing the total completion time as the optimization index, in which the processing time of the workpiece increases with time. A dynamic programming algorithm is designed to solve this problem. A robust single-machine scheduling problem with random machining times for workpieces is studied, with the goal of minimizing the total weighted makepan. A dynamic programming algorithm and a branch-and-bound algorithm are designed [7]. The dual-objective single-machine scheduling problem with rejectable workpieces is studied, and the optimization index is the total delay time. A dynamic programming algorithm is designed for the situation without delivery time constraints; a branch-and-bound algorithm is designed for the situation with delivery time constraints. The single-machine scheduling problem with common delivery time is studied. The optimization indicators are total weighted delay time and total weighted lead time. A dynamic programming algorithm is designed, and the computational complexity of the dynamic programming algorithm is further reduced. A complete polynomial is designed. Time approximation algorithm [8].

2.2. Design and Method of Safety Evaluation of Floating Oil Drum System

The basic principle of system design is to maximize the effect of the design work, and to continuously reduce the cost under the premise of ensuring the functional requirements of the purpose and the appropriate service life [9]. Therefore, the overall design scheme of the control system needs to be evaluated and analyzed before application. The design evaluation standard not only sets the standard for evaluating the level of the system, but also provides a guiding ideology for the system design as a system design principle, mainly from the following aspects for analysis and reference.

1. Ergonomics Practicality Ergonomics practicability is the primary evaluation content of the control system. As far as the control system in this paper is concerned, the most important thing is to realize functional control and make the production line realize automatic operation. The evaluation indicators are generally in the form of efficiency, accuracy, output, capacity, quality, power, etc. [10].

2. Operational stability Stability refers to whether the output volume will exceed the set limit range during the process that the output volume will passively deviate from the original stable value and transition to another new stable state when the input volume is disturbed or changed. Or a convergence state occurs, which is a sign of whether the system is stable. To ensure the stability of the system, on the one hand, it is necessary to ensure the rationality of the design of the system logic, and on the other hand, it requires the reasonable standardization of the selection and configuration of the external hardware system [11].

3. Amenity of operation Modern industrial design pays more and more attention to the unification of human, machine and environment, takes human-machine interaction as the starting point, and studies the friendliness of machine and environment to people [12]. For example, the position design of the operation buttons of the control cabinet in this text, the design of the visual operation interface of the industrial computer, etc., should consider the human operation habits and aspects such as color, temperature, humidity, angle, shape, touch, etc., which should be designed according to ergonomics. Principles are design criteria and are evaluated based on this [13].

4. The impact of environmentally sound industry on the environment has been paid more and more attention by all sectors of society, and the environmental soundness of the control system is mainly manifested in the human-computer interaction and operating environment of the control system. standard.

5. There are also evaluation contents in various aspects such as structural craftsmanship, modeling artistry, technical economy, and achievement standardization [14]. It needs to be evaluated from the aspects of system assembly, transportation and the rational use of its shape, quality and color. Among them, the most important standardization is standardization. Product standardization requires that all aspects of the product meet the technical standards stipulated by the state. Its importance lies in that standardized products can effectively ensure the reliability and stability of the system, and on the other hand, from the design point of view It is also conducive to the optimization and expansion of the system [15].

2.3. Application Status of Automatic Production Line Technology in Floating Oil Drum Treatment

(1) Automatic production line of floating oil drum processing system

The automatic production line of the floating oil barrel processing system includes: automatic barrel loading of oil barrels, heating of oil barrels, removal of front and rear covers of oil barrels, oil release, slitting and leveling of oil barrels. At present, there is no such production line in China. study [16]. Regarding the recycling and treatment of 200L waste empty oil drums, there are related researches, as follows: the waste empty oil drum treatment production line, after the waste empty oil drums are processed through a series of processing techniques such as shaping, cleaning inside and outside the barrels, drying, and painting, etc. Realize the secondary recovery and treatment of floating oil drums; the waste empty oil drum treatment production line, after the waste oil is packaged and pressed into iron blocks, is used as steel for secondary steelmaking recycling; the waste empty oil drum treatment production line, through simple Production equipment, after the floating oil drum is cut and decomposed, different parts of the floating oil drum are recovered with different values. The barrel cover of the floating oil drum is used as a steel-making material, and the barrel wall of the floating oil drum can be used as hardware, The raw material of toys can realize the high-value recovery of floating oil drums [17].

(2) Analysis of the overall structure of the production line

According to the analysis of the production function and processing technology requirements of the production line, a distributed PLC control system is used, each equipment is controlled by a separate PLC, and the main program in the Siemens design software is used to call the subprograms to complete the logic of the production line control [18]. When one of the PLCs fails, it will not affect the work of other PLCs in the production line. Therefore, the entire production line will not be paralyzed, the maintenance cost of the production line will be reduced, and the production capacity of the enterprise will be guaranteed. The control system of the production line The flow chart is shown in Figure 1 below:

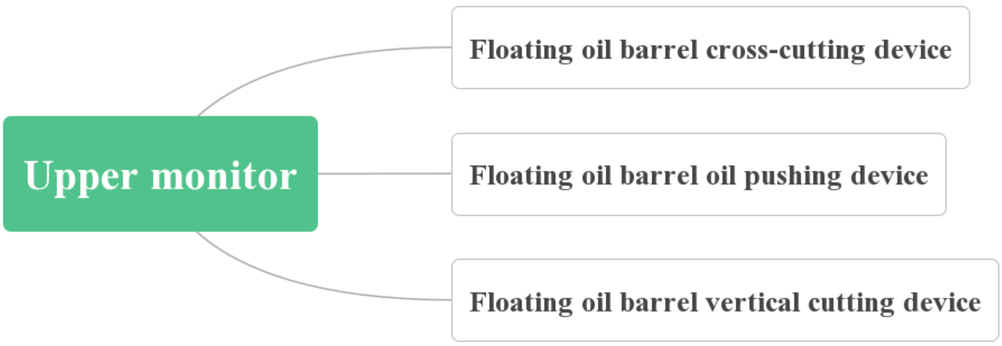

Figure 1. General framework diagram of the floating oil barrel system

In the design of the production line control system, the production line is divided into four separate control modules according to its processing process, and each module in the production line is individually designed [19].

3. Investigation and Research of Floating Oil Drum System in Ocean Engineering Based on Dynamic Programming Algorithm

3.1. System Test Test

The test equipment and materials include: oil drum refurbishment production line, production line control system, and 50 floating oil drums to be refurbished; the test environment is the equipment workshop of X Marine Machinery Co., Ltd.; the number of testers is 10.

experiment method:

1) 2 workers are assigned to the production line. Theoretically, the production line for the refurbishment of floating oil drums takes 30 minutes for one oil drum. When the floating oil drums are full, the processing rhythm is one barrel every 2 minutes. Taking 60 minutes as the quantitative time, test whether the processing of 18 floating oil barrels can reach the test index of "effective working rate = effective processing number/total number of oil barrels ≧ 80%" within the specified time, and obtain the effective working probability of the system.

2) Select 8 floating oil drum refurbishment workers to manually refurbish 32 floating oil drums, each worker is assigned 4 oil drums, and the refurbishment efficiency of oil drums is calculated with a time limit of 60 minutes.

3.2. Dynamic Programming Algorithms

In this section, a dynamic programming algorithm is designed to solve the optimal ordering rule of the system. In the formula, DPA includes a total of n iterations, and the state after each iteration is denoted as R. The state after the jth iteration is $R_j = (l, c_1, c_2, t)$. l is the completion time of the last workpiece processed before the cooling-standby interval; c_1 is the number of workpieces completed before the cooling-standby interval; c_2 is the number of workpieces processed after the cooling-standby interval; t is the finished workpiece 1, 2. .., the sum of TFT and TCE of j; let Z denote the optimal value. The dynamic programming algorithm is as follows:

$$For(l, c_1, c_2, t), (l, c_1, c_2', t') \in R_j, t \pi t' \quad (1)$$

$$Z = min(l, c_1, c_2, t) \in R_j \quad (2)$$

4. Safety Analysis and Research of Floating Oil Drum System in Ocean Engineering Based on Dynamic Programming Algorithm

The refurbishment production line of floating oil drums automatically runs 5 processing tests on 18 floating oil drums. Except for the two failures, the effective processing rate of the production line reaches more than 85%, which meets the control requirements of the research and improvement stage of the plant. But the problem is also obvious: the two system failures occurred, the first failure was caused by the mechanical gripper of the polishing station not tightening the oil drum, which caused the oil drum to fail to pop up during polishing; the second failure was due to the vibration of the production line during processing. The second time led to the sensor loosening and failure, and the other time, due to the serious deformation of the oil drum, the shaping machine could not be reshaped and failed. The production line processes 18 floating oil drums, and the efficiency statistics obtained after 5 tests are shown in Table 1 and Figure 2:

Table 1. Effective probability of processing 18 floating oil barrels in the production line

Times	1	2	3	4	5
Effective processing number (branch)	15	13	14	17	16
Failure machining (branch)	3	5	4	1	2
Uncompleted Number (Branch)	2	4	2	1	1
Number of system failures	1	3	1	0	1

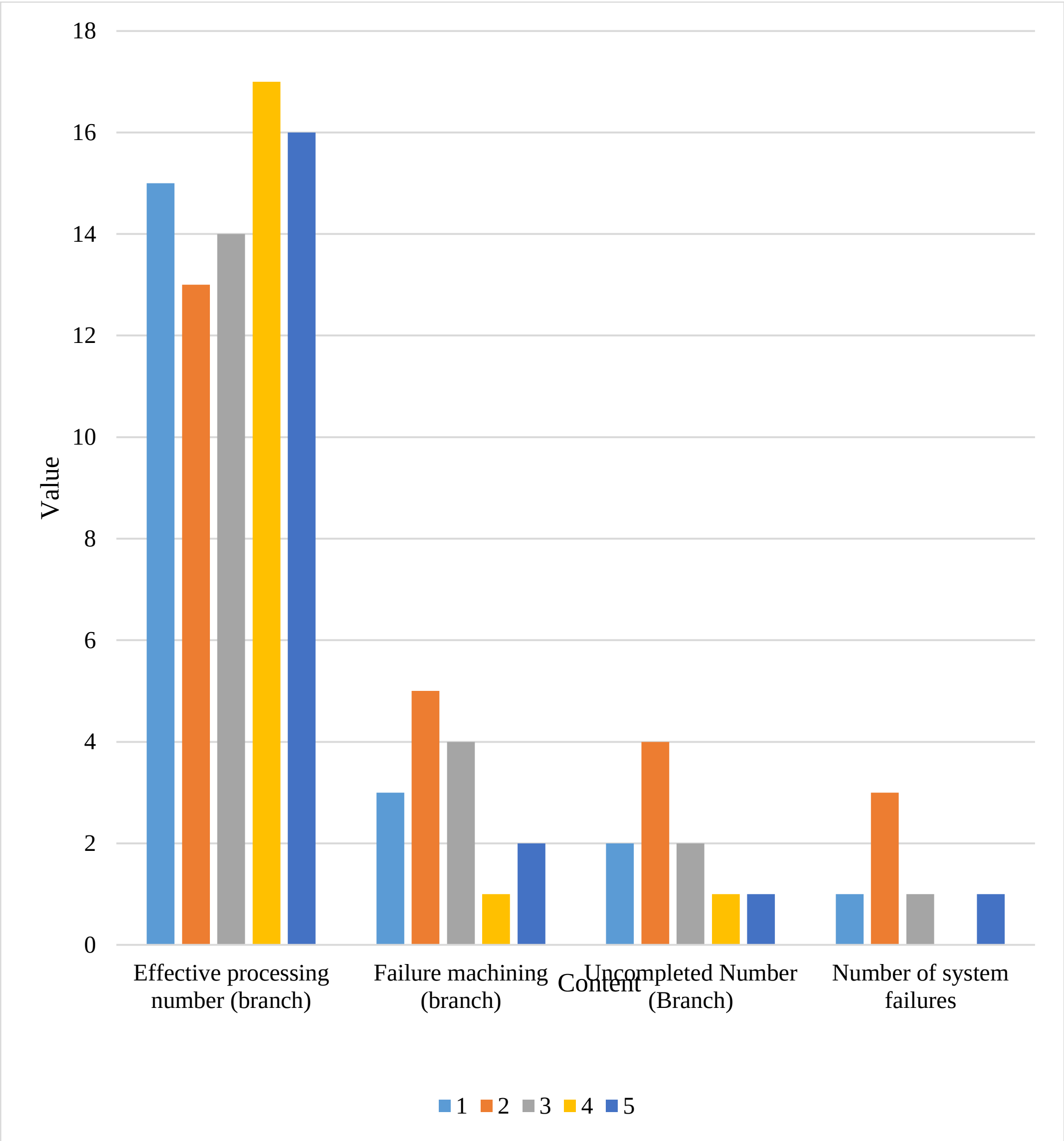

Figure 2. Effective probability of the floating oil barrel system

Compared with manual renovation, the work efficiency of the production line is about 10 times that of manual renovation, and the effective working probability is about 3 times that of manual work. 8 workers process 32 oil drums, and the efficiency statistics obtained in one test are shown in Table 2 and Figure 3:

Table 2. Workers' processing of floating oil data

Worker	1	2	3	4	5	6	7	8
Effective processing number (branch)	2	3	4	2	1	2	3	4
Failure machining (branch)	1	2	3	5	4	1	2	3
Uncompleted Number (Branch)	8	7	6	8	5	4	7	5

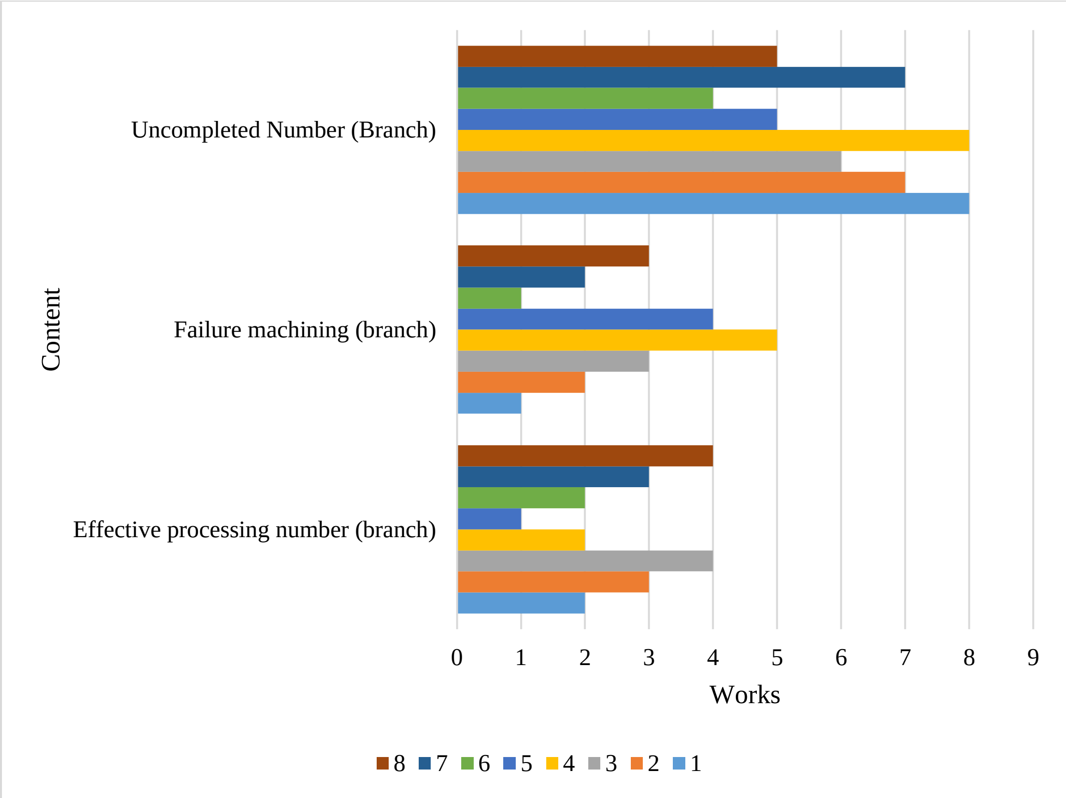

Figure 3. Effective probability of the floating oil barrel

Test conclusion: To meet the control requirements in the test stage, the floating oil drum system needs to be further improved from the following aspects: 1) The program structure of the system module needs to be optimized, and some problems in the process flow are exposed through this test, such as shaping Module, when controlling the shaping machine, because the shaping roller of the shaping machine is a cantilever beam structure, and the oil drum is in a state of unilateral stress during shaping, the shaping of the floating oil drum is very unstable. The oil drum can be reshaped by segment to complete the overall reshaping of the floating oil drum. 2) The safety of the floating oil drum system needs to be improved, and the automatic production line can easily lead to system failure, and the mechanical structure needs to be optimized. 3) The program structure of the floating oil drum system needs to be adjusted. It can be seen from the test that there are always two oil drums that cannot be processed within the specified time under normal working conditions. It is necessary to further analyze the process flow to optimize the program structure and improve the processing efficiency.

5. Conclusion

It is of great significance to improve the safety of floating oil drum systems in marine engineering. However, the lack of research on the safety of floating oil drum systems has led to bottlenecks hindering high-speed, healthy and vigorous improvement in related industries. In order to solve the problem of low safety and efficiency of the floating oil drum system and the problem of floating oil drum processing, a dynamic programming algorithm is proposed to increase the safety of the oil drum system, so as to combine the dynamic programming algorithm with the floating oil drum system. route.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Feder J . JIP Drives New Ways of Managing Integrity of Floating Oil and Gas Assets. Journal of Petroleum Technology, 2020, 73(4):37-38. https://doi.org/10.2118/0421-0037-JPT

[2] Richard C . Equinor explores floating wind to power North Sea oil and gas. Windpower monthly, 2018, 34(10):20-20.

[3] Pengle, Zhang, Yajie, et al. A fast dynamic programming algorithm to a varied capacity problem in vehicle routing. International journal of applied decision sciences, 2018, 11(2):146-167. https://doi.org/10.1504/IJADS.2018.090924

[4] Kira A , Inakawa K , Fujita T . A Dynamic Programming Algorithm For Optimizing Baseball Strategies. Journal of the Operations Research Society of Japan, 2019, 62(2):64-82. https://doi.org/10.15807/jorsj.62.64

[5] Ina, Siti, Hasanah, et al. Optimization preventive maintenance of equipment production on palm oil mill. IOP Conference Series: Materials Science and Engineering, 2019, 505(1):12155-12155. https://doi.org/10.1088/1757-899X/505/1/012155

[6] Xu E G , Khursigara A J , Li S , et al. mRNA-miRNA-Seq Reveals Neuro-Cardio Mechanisms of Crude Oil Toxicity in Red Drum (Sciaenops ocellatus). Environmental Science & Technology, 2019, 53(6):3296-3305. https://doi.org/10.1021/acs.est.9b00150

[7] Ojo, Ademola, J, et al. Modeling and Simulation of Two-Staged Separation Process for an Onshore Early Production Facility. Advances in Chemical Engineering and Science, 2019, 9(2):127-142. https://doi.org/10.4236/aces.2019.92010

[8] Popa A L , Drumea V , Roxana-Andreea N I , et al. A physico - chemical characterization of oil from Camelina sativa seeds grown in Romania. Romanian Biotechnological Letters, 2019, 24(5):776-782. https://doi.org/10.25083/rbl/24.5/776.782

[9] Aliiev E . Justification of constructive-mode parameters of a photo-electron separator of sunflower seeds. Scientific Horizons, 2019, 79(6):23-30. https://doi.org/10.33249/2663-2144-2019-78-5-23-30

[10] Sain M , Sharma A , Arora G , et al. Thermic Fluid Based Solar Thermal Energy Storage System for Milk Processing. International Journal of Current Microbiology and Applied Sciences, 2019, 8(10):1962-1973. https://doi.org/10.20546/ijcmas.2019.810.229

[11] Salas D F , Powell W B . Benchmarking a Scalable Approximate Dynamic Programming Algorithm for Stochastic Control of Grid-Level Energy Storage. Informs Journal on Computing, 2018, 30(1):106-123. https://doi.org/10.1287/ijoc.2017.0768

[12] Drumond A , Sales J , Zuchi J , et al. Physiological quality of castor seeds (Ricinus communis L.) after processing. Journal of Seed Science, 2019, 41(2):224-232. https://doi.org/10.1590/2317-1545v41n2215551

[13] *Jararweh Y , Al-Ayyoub M , Fakirah M , et al. Improving the performance of the needleman-wunsch algorithm using parallelization and vectorization techniques. Multimedia Tools and Applications, 2019, 78(4):3961-3977. https://doi.org/10.1007/s11042-017-5092-0*

[14] *Karpov D A , Struchenkov V I . Dynamic programming in applied tasks which are allowing to reduce the options selection. Russian Technological Journal, 2020, 8(4):96-111. https://doi.org/10.32362/2500-316X-2020-8-4-96-111*

[15] *Ribault A , Vercraene S , Henry S , et al. Economically Optimal Control of a Cold Room Using an Artificial Neural Network and Dynamic Programming. IFAC-PapersOnLine, 2019, 52(13):2002-2007. https://doi.org/10.1016/j.ifacol.2019.11.497*

[16] *Wani M A , Ahmad M . Statically Optimal Binary Search Tree Computation Using Non-Serial Polyadic Dynamic Programming on GPU's. International journal of grid and high performance computing, 2019, 11(1):49-70. https://doi.org/10.4018/IJGHPC.2019010104*

[17] *Hajiamini S , Shirazi B , Crandall A , et al. A Dynamic Programming Framework for DVFS-Based Energy-Efficiency in Multicore Systems. IEEE Transactions on Sustainable Computing, 2020, 5(1):1-12. https://doi.org/10.1109/TSUSC.2019.2911471*

[18] *Sharifian V , Zahraie B , Hassanzadeh Y , et al. Optimization of Hydropower Dam Design Parameters for Adaptation to Climate Change using stochastic dual dynamic programming algorithm (SDDP). Indian Journal of Science and Technology, 2018, 11(22):1-11. https://doi.org/10.17485/ijst/2018/v11i20/113637*

[19] *Ad A , Oda B , Rba C . Stochastic dual dynamic programming with stagewise-dependent objective uncertainty. Operations Research Letters, 2020, 48(1):33-39. https://doi.org/10.1016/j.orl.2019.11.002*