The Satellite Downlink Replanning Problem: A BP Neural Network and Hybrid Algorithm Approach for IoT Internet Connection

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Abstract- *In the time of the Internet of Things, the job of a satellite has turned out to be progressively vital. The utilization of satellite assets can address the issues of fast Internet association of the Internet of Things. Viable correspondence among satellites and the ground is vital. This paper proposes a fitting blend approach that depends on an improved hereditary calculation (GA) for a satellite downlink replanning issue. The underlying populace of the GA is upgraded utilizing a back propagation (BP) neural system (NN). Initial, an assortment of planning plans is utilized to prepare the BP NN, and qualities are extricated through self-versatile learning. The NN show in the wake of preparing gives a decent starting answer for the information data of the GA. This half and half calculation (HA), which comprises of a booking GA and a neighborhood look calculation, can rapidly total the replanning of the downlink task arrangement. The capacity of the HA is improved by the BP NN. A progression of investigations is utilized to demonstrate the legitimacy of the HA. As uncovered in the aftereffects of various scale occurrences, the proposed calculation performs superior to other booking calculations.*

I. INTRODUCTION

Satellites hold an imperative position in both the com-mercial and military fields, particularly in the present Internet of Things (IoT). This is inseparably connected with their ability to give administrations, for example, interchanges, asset observing, and calamity expectation. Satellite communications, situating, and route. There is a lot of information connection in the Internet of Things, which requires rapid correspondence for help. Satellite-based information sending and down linking are additionally critical pieces of net-work network. High-throughput satellites (HTS), low earth circle (LEO) or geostationary (GEO) satellite frameworks are as of now being used. The satellite is situated in the system layer all through the IoT chain of command. As more mission requirements compare to higher prerequisites for satellite frameworks, the powerful control of the satellite has turned into an issue of incredible concern. While day by day satellite control is moderately developed and settled regarding satellite asset management, the satellite frameworks regularly experience surprising circumstances. In such occurrences, crisis undertakings may require the framework to react rapidly and produce mission.

Arranging procedure. This procedure is called satellite mission replanning (SMR) [1], [2].

The objective of this paper is to build up a model and calculation for comprehending a SDRP. In view of the foundation of the scheduling plan information, the Back Propagation (BP) neural system is utilized to help basic leadership, amplify the advantages of the assignment, and complete whatever number information downlink undertakings as would be prudent. A satellite downlink replanning issue includes the star access of assigning satellite and ground station assets and downloading legitimate information to the ground stations. In particular, a SDRP contains countless solicitations and a constrained accessible time window of ground stations [3], [4]. In spite of the fact that it is sensible to plan mission downlinks to improve by and large benefit [5], there are a few requirement conditions. For instance, (1) each undertaking must be downloaded inside a restricted time go; (2) the downlink procedure can't be hindered once it begins; (3) every reception apparatus can just help, at most, one errand at any given moment; (4) after an information downlink task is finished, another assignment must be begun inside a specific timeframe; (5) the information transmission ability of the receiving wire equivalent.

As of late, satellite information downlink assignments have quickly expanded with the expansion in the quantity of satellites in circle [6]. In like manner, ground control focuses produce plan-ning programs that can be utilized to manage the consequent undertaking re-arranging process by mining their qualities. The BP neural system can get to a choice model via preparing numerous examples and can create an amazing beginning arrangement before replanning.

This issue is a common NP-difficult issue [7] whose principle include is over subscripted. Research here is commonly isolated into exact arrangement calculations, heuristic calculations, and meta-heuristic calculations [8] – [14]. In little scale scenes, a heuristic calculation or precise arrangement calculation can accomplish great outcomes, yet when the undertaking size builds, it isn't troublesome for the careful arrangement calculation to accomplish great outcomes, yet it is additionally troublesome for heuristic calculations to gauge the speed and arrangement quality [14], [15]. In handy applications, an expansion in the quantity of errands builds the prerequisites of the arrangement calculation. Intelligent advancement calculations, for example calculation has a quick assembly dueto the extent of the populace. Accordingly, some hereditary calculation improvement methodologies have turned into a prevalent subject for local and remote researchers. Utilizing the area seek technique or nearby inquiry strategy in blend with the hereditary calculation can improve the arrangement and in this way draw it nearer to streamlining [17], [18]. What's more, the nature of the underlying arrangement to a great extent impacts the enhancement consequence of the hereditary calculation [19], [25]. BP neural system is extremely compelling with regards to huge information [21] – [23]. As needs be, utilizing the expectation aftereffects of the BP neural system. This article is organized as pursues. In the second segment, a portrayal of the SDRP is exhibited and the issue definition is examined. In the third area, a few calculation. A BP neural system display is utilized to prepare subsequent to planning, and a half and half hereditary calculation is utilized to enhance the arrangement. In the fourth segment, the calculation is confirmed utilizing situations with various highlights.

II. PROBLEM FORMULATION

AVAILABLE DATA SET

Let A be the set of available antennas. There are N available time windows. Each time window is described as e_j, l_j .

Let R be the set of satellite data downlink requests. There are M tasks in total. Each $r_j \in R$ contains several attributes which are represented as r_j ei_j, es_j, le_j, d_j, pr_j, i_j . The meanings of these attributes are:

- *eij : end time of picture procurement of solicitation rj ∈ Res$_j$* : earliest data download start time of request $r_j \in R$
- le_j : deadline of data downlink of request $r_j \in R$
- d_j : duration of the data downlink of request $r_j \in R$
- pr_j : the profit of request $r_j \in R$
- i_j : task conversion interval of request $r_j \in R$

B. DECISION VARIABLES

Let s_j be the downlink start time of request r_j R; if the request is unscheduled, it will be set at 0.

Let x_j be 1 if the task j is scheduled; otherwise, it will be set at 0;

C. MODEL

The SDRP must complete more tasks while also ensuring the high revenue of the task. Therefore, our objective function is to maximize the mission benefits. Hence, the model is described as follows:

$$f(\phi) = \sum_{i=1}^{M} \sum_{j=1}^{N} x_{ij} p_i / (s_i - e_i) \quad (2)$$

D. CONSTRAINTS

- Each task can be executed only once.

$$\sum_{j=1}^{N} x_{ij} \leq 1, i \in R \quad (3)$$

- Data downlink tasks must be performed after the imaging task is completed.

$$ei_i \leq s_i \ (i \in R) \quad (4)$$

- No overlap is allowed between tasks.

$$s_i + d_i - s_k < 0, \quad i \in R_0, k \in R, \ i \neq k \quad (5)$$

- The task must be completed before the deadline.

$$s_i + d_i - le_i \leq 0, \quad i \in R \quad (6)$$

- The start of the task must be after the conversion time of the previous task.

$$s_i + d_i + i_i \leq s_k, \quad i \in R_0, k \in R, \ i \neq k \quad (7)$$

The model comprises of choice factors and undertaking income. From one viewpoint, it is important to organize high-benefit undertakings for booking. Then again, the quantity of finished assignments must be considered.

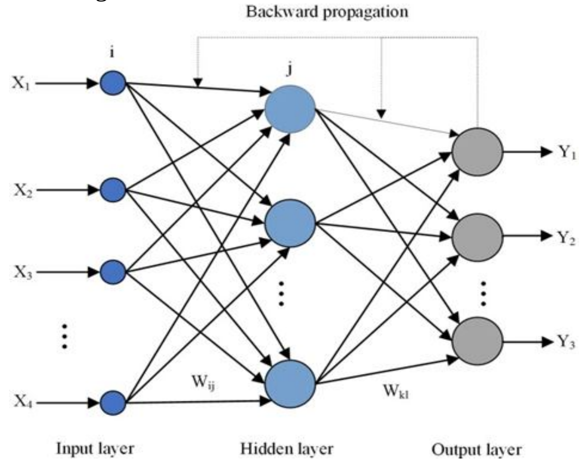


FIGURE 1. BP Neural Network. The BP neural network consists of the input layer, hidden layer and output layer. Input layer: end time, size, duration and latest time; Output layer: schedulable results.

III. METHODS

To settle the SDRP, the BP neural system is utilized to gauge the planning plan. Following that, the proposed HA is utilized to finish the enhancement of the booking plan dependent on the anticipated errand schedulability. In the undertaking scheduling process, a heuristic calculation alluded to as TLSA is proposed. The mix of the BP neural system and HA can adequately settle the SDRP.

A. BP NEURAL NETWORK

The BP neural system yields the expectation display via training the current arranging plan [19], [20]. The BP neural system is then used to anticipate the errand set that must be scheduled for booking. The consequence of the schedulability of the assignment is utilized to enhance the outcomes. The schematic graph of the BP neural system is introduced in Figure 1. The BP neural system can mine valuable data about errands, scenes, and satellite states through learning and decide if the undertaking is in the information download task booking plan. The BP neural system incorporates three sections, to be specific, the info layer, concealed layer, and yield layer [24]. In the accompanying, the BP neural system settings related with these three dimensions are as per the following.

1) INPUT LAYER

The input layer is in charge of contributing data identified with information downlink assignments, mission situations, and so on. including the end time of the imaging task, the span of the information downlink task, the length of the information downlink task, and the most recent information downlink times for every one of these five traits.

2) HIDDEN LAYER

As per the attributes of the issue, we pick the single shrouded layer as the concealed layer model of the BP

TABLE 1. Four cases of task location move.

Status	Move
$s_i \le e_j \le s_i + d_i \le l_j$	(+)
$e_j \le s_i \le s_i + d_i \le l_j$	(-)
$e_j \le s_i \le l_j \le s_i + d_i$	(+)
$l_j \le s_i \le s_i + d_i$	(-)

Neural network. The activation function is the Logsig function, and the function's expression isf (x)log sig = 1/(1+e−x).

3) OUTPUT LAYER

The yield layer yields the model's schedulable outcomes in the wake of learning. After forward and in reverse engendering, a lot of results somewhere in the range of 0 and 1 is acquired where 1 shows that the assignment ought to be arranged and booked and 0 demonstrates that the undertaking isn't in the planned groupings.

B. ONE PROPOSED CONSTRUCTION HEURISTIC ALGORITHM

It is additionally essential to decide the begin time of the download contrasted with deciding the arrangement of errands to be performed. The connection between satellite information downlink assignments and ground station unmistakable time windows is exhibited in Figure 2. From among the four cases, there are two assignments that must be moved, one that shouldn't be moved, and one (the last one) that legitimately thinks about the errand in whenever window. The outcomes are shown in Table 1.

As indicated by the tenets masterminded preceding the errand, we proposed an assignment area determination calculation (TLSA) for satellite information downlink undertakings to plan time for a given arrangement of assignments and get accessible arranging. The two key pieces of the TLSA are to choose which assignments to download and when to start the present undertaking.

The TLSA can be used to plan and schedule the sequence of each task in the HA that is proposed later to ensure the efficiency while simultaneously focusing on the quality.

C. HYBRID ALGORITHM (HA)

To viably improve the nature of the SDRP's answer, a planning hereditary calculation (SGA) for huge scale seeks is proposed. As the quantity of emphases builds, the accu- indecent of the arrangement must be improved. A neighborhood look algorithm (LSA) is likewise proposed.

Consolidating the two calculations not just ensures a productive scan for all arrangement spaces yet in addition moves the outcomes in the wake of arranging nearer to the ideal arrangement of the issue. The underlying arrangement of the HA is acquired by the BP neural system expectation of the errand set, which ensures the nature of the underlying arrangement.

1) SCHEDULING GENETIC ALGORITHM (SGA)

The SGA is an improved genetic algorithm for generate- in a selected set of tasks. The algorithm includes initial

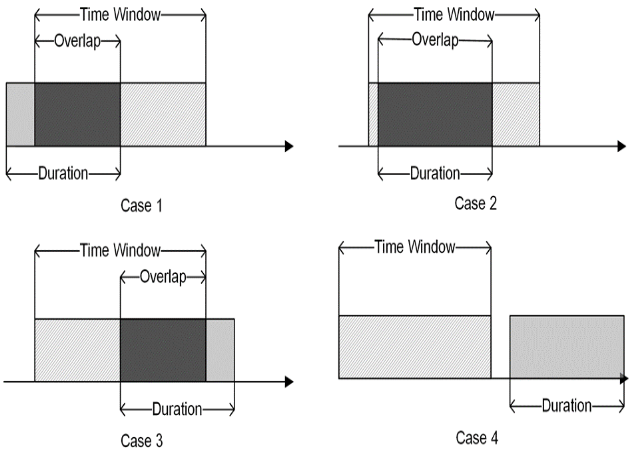


FIGURE 2. Four cases regarding the time window and the task.

population generation, selection, crossover, mutation, population of individual assessment, and generation of new populations.

A: INITIAL POPULATION

The underlying populace utilizes the BP neural system to design the planning arrangement that must be slated for booking. People in the populace can perform nearby quality as per the underlying planning plan to guarantee the assorted variety prerequisites. As populace measure setting influences the nature of the arrangement, few people can't ensure the nature of the arrangement and such a large number of people can prompt low arrangement effectiveness. Along these lines, a coding technique that progressively sets the underlying populace estimate as per the assignment scale is utilized, and the coding strategy for the populace is genuine coded.

B: FITNESS

The fitness calculation of each individual in the population invokes the TLSA proposed in the previous section.

C: SELECTION

The determination activity is performed by methods for roulette, and the choice depends on the extent of individual wellness esteems in the populace.

D: CROSSOVER

Since the populace is encoded in genuine coding, the two-point recombination strategy is utilized as opposed to the hybrid technique. In particular, two irregular quality fragments in the individual are chosen to be traded for the places of the two arbitrary sections.

E: MUTATION

Transformations are performed utilizing the arbitrary trade of two qualities in a populace. Notwithstanding, changes are just per-shaped when they are not exactly the likelihood of transformation.

The general progression of the SGA is appeared as follows. The stop standard of the SGA sets the quantity of emphases as per the size of the issue, and the ensuing neighborhood look generally relies upon the outcome acquired by the SGA.

2) LOCAL SEARCH ALGORITHM (LSA)

The nearby inquiry calculation is an improvement procedure expert presented to additionally improve the income of the SGA. Utilizing the aftereffects of the SGA as the underlying arrangement of the nearby hunt can guarantee that the HA does not turn into a neighborhood ideal circumstance and that it can successfully decrease.

IV. EXPERIMENTAL ANALYSIS

A. EXPERIMENTAL SETTINGS

1) EXPERIMENTAL ENVIRONMENT

The proposed algorithms are implemented by Matlab2017a on a desktop with Core I7-7700 3.6 GHz CPU, 8 GB memory, and Windows 7 operating system.

2) TEST INSTANCE

Three low, medium, and high task-scale instances were developed for high earth orbit (HEO) satellites, low earth orbit (LEO) satellites, and hybrid missions of two types of satellites. These instances are generated randomly under consideration of the actual operational capabilities of the satellites to avoid the dependence of the algorithm on the problem

Algorithm 1 Task Location Selection Algorithm (TLSA)

Input: A set of antennas A and time windows, and a set of data downlink requests R.

Output: An executable solution S
Step 1: Provide a set of satellite data downlink tasks and a set of available time windows for ground stations;
Step 2: If the unplanned task set is not empty, enter the next step; otherwise, go to Step 10;
Step 3: Add the conversion time of the task to the task in the task collection;
Step 4: Select a task from the task set, find the available time window to perform the task, enter the next step; otherwise, go to Step 10
Step 5: Select the earliest available time window, compare the duration of the task and the length of the available time window; if it is longer than the length of the available time window, go to Step 10;
Step 5.1: Compare the imaging end time with the antenna start time window start time. If earlier than the start time, go to step 6; otherwise, go to the next step;
Step 5.2: Select the earliest time that can be downloaded as the start time for the data downlink, then go to step 7; Step 6: Take the earliest visible time of the ground station as the start time for the data transmission, then arrange the tasks at this location and proceed to the step 7;
Step 7: Update the unplanned task set and task scheduling scheme;
Step 8: Update the time window;
Step 9: If there are unplanned tasks, go back to step 2; otherwise, go to the next step;
Step 10: Output planning scheme S.

Structure. In the case of LEO satellites, global targets and regional targets are also one of our considerations. In the case study scale, 50, 100, 150, 200, 300, 500, 750, and 1000 tasks are set. For satellite ground station time windows, 22 ground station visible time windows were allowed. The experiments use these test instances and ground station visible time windows.

3) SATELLITE ORBITAL PARAMETERS

The tests depend on a few LEO satellites and HEO satellites in China. The underlying orbital parameters of one of the satellites are given. The areas of satellites in space are described by six orbital parameters: the length of the semi-significant hub (LSA), flightiness (E), tendency (I), contention of perigee (AP), right rising of the rising hub (RAAN), and mean irregularity (MA). The underlying orbital parameters for the satellite are exhibited in Table 2.

4) GENETIC ALGORITHM PARAMETERS

The issue includes a wide assortment of assignments. Populace measure and different parameters are balanced by the size of the task. The

Algorithm 2 Scheduling Genetic Algorithm (SGA)
Input: A set of antennas A and time windows, a set of data downlink requests R, and initialized population P Output: A best solution S
Step 1: Calculate the initial population fitness;
Step 2: Record the best individual and fitness of the current generation, and record the worst individual;
Step 3: Conduct the genetic operation;
Step 3.1: Select individuals in the population based on roulette;
Step 3.2: If the random probability is greater than the recombination probability, perform the two-point regroup operation; otherwise, proceed to Step 3.3;
Step 3.3: If the random probability is greater than the mutation probability, perform the mutation operation; oth- erwise, proceed to Step 4;
Step 4: Calculate the individual's fitness in the population after conducting the genetic operation;
Step 5: Compare the fitness value of the optimal individual to the optimal value of the previous generation population after the genetic operation; if it exceeds the fitness value of the previous generation, update the optimal individual information in the population;
Step 6: Discard the worst individual in the previous gener- ation;
Step 7: Return to Step 2 until the number of iterations exceeds the threshold, then go to the next step;
Step 8: Output optimal solution S.

TABLE 2. Satellite orbital parameters.

Parameter	LSA	E	I	AP	RAAN	MA
Value	71417 01.7	0.0006 27	98.596 4	95.506 9	342.30 7	125.26 58

TABLE 3. Genetic algorithm parameter settings.

Parameter	Crossover	Mutation	Population	Generation
Value	0.9-0.95	0.05-0.1	*Tasks*/5-*Tasks*/10	500-2000

settings are presented in Table 3.

B. EXPERIMENTAL RESULTS

We originally structured a case for the low-circle satellite's three kinds of undertakings: high-medium-low assignment measure, chose GA calculation [5], nearby pursuit calculation [25], and two heuristic calculations, explicitly, normal benefit first (APF) and duration first (DF). For each assignment estimate, two situations are planned, specifically, worldwide missions and local missions. Investigations on low earth circle

(LEO) satellites in little scale worldwide missions were directed. The outcomes are introduced in Table 4.

In the arranging of LEO satellites for little scale worldwide missions, the HA shows the most elevated income execution in all scenarios. The performances of the three meta-heuristic algorithms and the two heuristics are relatively close. Even the DF algorithm in heuristics aproaches the HA in three scenarios with 50 task sizes. This is because the duration of the low-orbit missions is short, the missions are sparse with fewer missions, and the conflicts between missions are small. Hence, most missions can be arranged in close to optimal locations. When the task size rises from 50 to 100, the gap between the revenue of meta heuristics and heuristics increases. In the heuristic algorithm, there is uncertainty in the performance of the APF and DF in different scenarios. A task completion rate experiment is then designed for the LEO satellites' small-scale regional missions. The results are presented in Table 5.

TABLE 4. Revenue on small-scale global mission of LEO satellites.

Problems	Meta Heuristic Algorithm			Heuristic Algorithm	
	HA	GA	LS	APF	DF
50-1	**6.6507**	6.6133	6.6061	6.1866	6.0501
50-2	**5.4123**	5.3952	5.2970	5.2724	5.2623
50-3	**2.9404**	2.9435	2.9228	2.9218	2.9216
100-1	**18.3972**	16.8022	14.5728	12.0965	11.1475
100-2	**25.0359**	25.0057	9.7705	9.7523	9.5925
100-3	**8.7412**	8.6973	8.7395	7.5991	8.0265

TABLE 5. Completion rate for small-scale regional mission of LEO satellites.

Problems	Meta Heuristic Algorithm		Heuristic Algorithm	
	HA	GA	APF	DF
50-1	**100.00%**	98.00%	100.00%	100.00%
50-2	**100.00%**	100.00%	100.00%	100.00%
50-3	**90.00%**	86.00%	84.00%	90.00%
100-1	**98.00%**	90.00%	88.00%	92.00%
100-2	**100.00%**	96.00%	97.00%	99.00%
100-3	**83.00%**	79.00%	77.00%	80.00%

We just chose the HA, GA and the calculations for the APF and DF to look at the undertaking finishing rates in light of the fact that the HA utilizes the idea of the LSA and has a solid similitude in achieving more assignments. The centrality of this compare-child is exceptionally little. Moreover, just the aftereffects of these four calculations are analyzed in our resulting task finish rate tests.

In the three scenarios of 50 tasks, the results of the four algorithms are similar in that they all can accomplish a similar number of downlink missions of satellite data and the multiple scenes achieve a mission completion rate of 100%. However, compared with the HA, the other three algorithms exhibit scenario dependency and the results of the algorithm are unstable. The dependence on the scenario is more obvious when the task size is 100 with the DF algorithm yielding similar planning results to those of the HA in the 100-2 scenario. However, in the other two scenarios that contain 100 data downlink tasks, the DF algorithm does not perform well.

TABLE 6. Revenue for medium -scale global mission of LEO satellites.

Problems	Meta Heuristic Algorithm			Heuristic Algorithm	
	HA	GA	LS	APF	DF
150-1	**19.7709**	19.2873	17.2373	12.5996	12.6033
150-2	**24.9213**	22.5722	24.7207	19.9777	17.0560
150-3	**17.1517**	16.8807	17.1499	13.3444	13.8112
200-1	**22.1373**	19.3714	21.8852	11.8221	12.1460
200-2	**29.9392**	25.9215	29.3162	21.6704	21.8471
200-3	**18.5799**	15.4960	18.1808	13.8344	11.4513

TABLE 7. Completion rate of medium -scale regional mission of LEO satellites.

Problems	Meta Heuristic Algorithm		Heuristic Algorithm	
	HA	GA	APF	DF
150-1	**80.67%**	72.67%	70.00%	71.33%
150-2	**94.67%**	88.67%	87.33%	85.33%
150-3	**77.33%**	76.00%	74.67%	75.33%
200-1	**83.50%**	61.50%	54.00%	55.00%
200-2	**95.00%**	72.50%	72.00%	78.50%
200-3	**79.00%**	77.00%	78.50%	79.00%

Thus, the task size is increased to 150 and 200 for medium-scale experiments. The results are presented in Table 6.

After the information downlink errands achieve the dimension of the medium scale, the hole between the income of the meta-heuristic calculation and the heuristic calculation increments. In the meta-heuristic calculations, the GA's arranging results are genre-partner not in the same class as those of the LS calculation, and the hole between the LS and the HA builds contrasted with the little scale worldwide undertakings, in this manner mirroring the improvement in the HA's critical thinking after the calculation is blended. The improvement of the arrangement of the HA to a great extent relies upon the improvement of the underlying arrangement. Following this, the achievements of the HA's undertaking for the territorial mission of the medium-scale mission are examined. The outcomes are displayed in Table 7.

With respect to the completion rate of the task, it is similar to the pattern of the task revenue under the medium-scale task scenarios. The task completion rate gap between meta heuristics and heuristics increases, and the advantages of the LSA is used to further optimize the solution and constantly try to change the structure of the solution to achieve the implementation of a large number of tasks. In the scenario of 200-2, the gap between the completion rate of the task of the HA and APF is as high as 23% and that of the DF is as high as 16.5%. Accordingly, it is concluded that the gap between the algorithms is significant. We next expanded the scale of the task to 300, 500, and 1000 and compared the performance of the algorithm in large-scale task scenarios. The results are presented in Table 8.

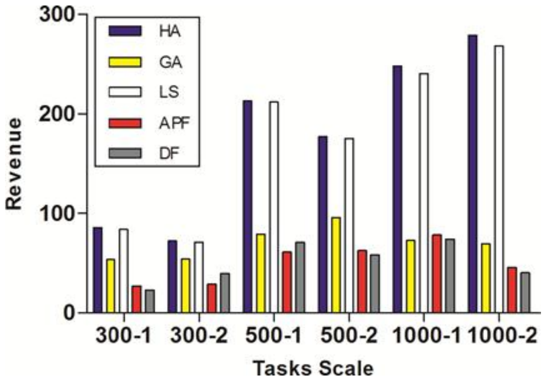
As large-scale task scenarios require high efficiency when solving the SDRP, the same running time was selected to compare the results of the algorithm. After a large-scale task

TABLE 8. Revenue for Large-scale global mission of LEO satellites.

Problems	Meta Heuristic Algorithm			Heuristic Algorithm	
	HA	GA	LS	APF	DF
300-1	**34.9533**	23.6981	34.9358	14.0676	12.2632
300-2	**42.9873**	30.5871	42.6286	26.8800	22.7859
500-1	**62.6494**	39.8824	61.3701	26.5496	29.0011
500-2	**68.4529**	41.4378	64.5728	30.4752	26.4663
1000-1	**105.5165**	44.9852	98.4241	37.3123	24.4282
1000-2	**123.4321**	56.3370	121.6753	48.9227	35.9398

Execution time increments too. As needs be, because of the contention, the undertaking can't be finished. This outcome is very much delineated in Table 9.

After the errand increments to 300, the assignment fulfillment rate is decreased to beneath 80%. With the exception of the 500-1 situation, the finishing rate is 86.6% because of the undertaking structure. Further-more, the undertaking consummation rate in different situations keeps on diminishing as the assignment estimate increments. At the point when the undertaking scale is 1000, the assignment fruition rate after HA arranging can just approach 60%. The downlink consequences of the HEO satellite worldwide target assignments demonstrate that the arrangement calculation essentially influences the arranging results. Especially, after the size of the errand is expanded to 500 and 1000, the heuristic calculation couldn't effectively take care of the SDRP issued.



The second piece of the investigation is led on the mission of information downlink undertakings of high earth circle (HEO) satellites. HEO satellites have a more drawn out perception window than LEO satellites and can perform more perception assignments. Correspondingly, the downlink time of HEO satellites has a higher time window prerequisite, and consequently, the achievement rate of errand execution is low.

The benefit for worldwide target information downlink errands of HEO satellites is shown in Figure 3.

TABLE 8. Revenue for Large-scale global mission of LEO satellites.

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	HA	GA	LS	APF	DF
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1000-2	**123.4321**	56.3370	121.6753	48.9227	35.9398

Because of the huge scale assignments of HEO satellites, in light of the fact that there is a higher asset necessity for ground station time windows, the culmination of downlink missions for HEO satellite information is lower than that of LEO satellites in general. At the point when the errand scale achieves 1000, HA's undertaking finish rate is under half, and the other three assignment consummation rates are around 30%. From this outcome, it is obvious that the size of the issue of the SDRP firmly impacts the last arranging outcome. At the point when the contentions between errands increments to the situation where different assignments are in struggle, the HA in the long run achieves the rehashed enhancements of the arranging plan, in spite of the fact that there are numerous undertakings that can't be downloaded.

Another arrangement of trials was then directed to consider the half breed mission arranging issue of the HEO and LEO satellites amid the genuine application process. The half and half missions of the HEO and LEO satellites considered three scenarios, to be specific, little scale, medium-scale, and vast scale. To begin with, the SDRP was performed for the half breed mission of little scale HEO and LEO satellites. The outcomes are presented in Figure 4.

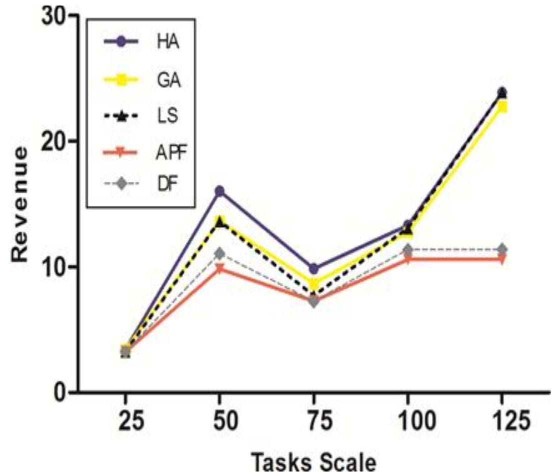

FIGURE 4. HEO & LEO satellite small-scale hybrid mission revenue.

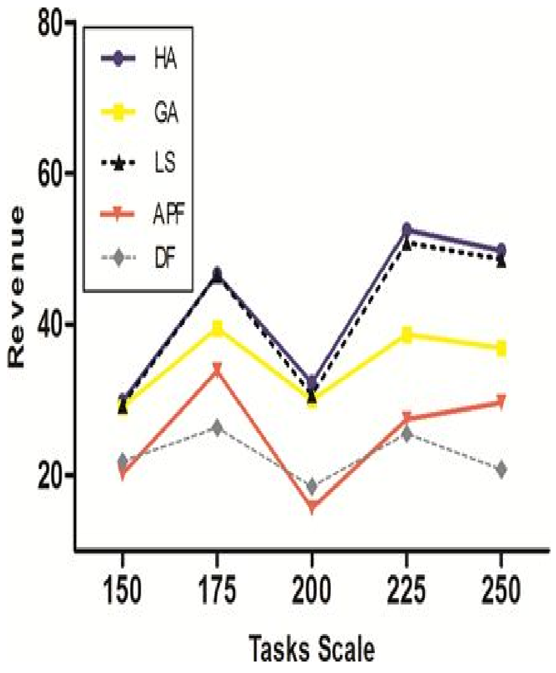

FIGURE 5. HEO & LEO satellite medium-scale hybrid mission revenue.

In little scale situations, the consequences of the HA and LS are moderately close, mirroring that the HA can estimated the ideal answer for little scale assignments. Henceforth, medium mission-scale trial of HEO and LEO satellites were then directed. The outcomes are displayed in Figure 5.

In the medium-scale situation, the calculation's income results are generally steady, and the HA and LS have littler benefit holes. It is additionally noticed that when the size of the errand increments from 225 to 250, the undertaking income does not increment. This mirrors the effect of the errand strife that was recently referenced. The expansion in the quantity of contentions has brought about numerous assignments with higher returns recording results, and henceforth, the loss of those undertakings.

As the undertaking scale further increments, as introduced in Figure 6, the hole between the HA and LS, just as a few other algorithms, increments in the SDRP after 400 errands. In the meantime, the hole between the HA and LS has additionally expanded, mirroring the viability of the BP neural systems and the improved hereditary calculations for substantial scale undertakings.

The SDRP experiments of the HEO and LEO satellites are combined to verify that the HA proposed in this paper is effective in solving the problem and completing the task.

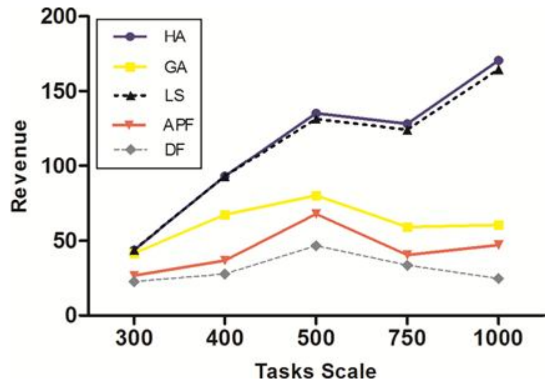

FIGURE 6. HEO & LEO satellite large-scale hybrid mission revenue.

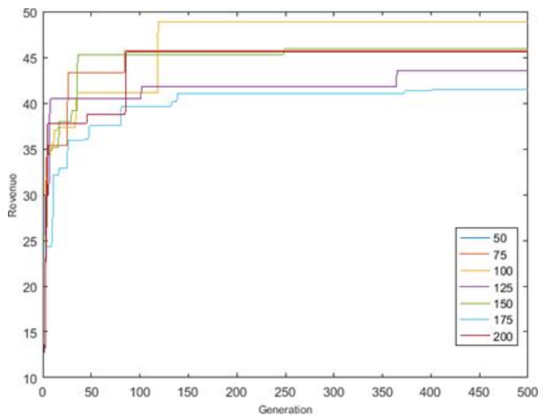

FIGURE 7. Effects of parameter settings on different population sizes.

The after effects of the forecast are acquired by utilizing the BP neural system as this system can make the underlying arrangement progressively good to the later improvement and can utilize the HA to constantly upgrade the outcomes to accomplish the most ideal arranging results

C. PARAMETRIC ANALYSIS

Experiments for verifying population size setting select a large-scale task scenario in the case of a mixed task. The number of tasks selected is 1000, and the number of iterations is 500 generations, of which the number of missions for a high-orbit satellite data set does not exceed 30%. The initial population is used as a base throughout the experiment. The results are presented in Figure 7.

Figure 7 demonstrates that inside the scope of 500 generations, as the populace measure builds, the impact of the hereditary calculation improves to some degree. At the point when the population measure is 100, the impact is getting it done. Not with standing, when the populace measure builds, the assignment's consummation salary starts to decrease. Hence, it is clear from this trial that the populace measure setting incredibly impacts the effect of the HA on the answer for the SDRP.

CONCLUSION

This paper considers the issue of satellite information downlink replanning issue for Internet of Things (IoT) web association. This paper built a numerical model for the SDRP and proposed a half and half calculation (HA). In the HA, the expectation of a given arrangement of errands by the BP neural system is incorporated and the outcomes showed that the improved hereditary calculation on the arranging plan is quickly improved and the LSA is additionally improved in the arrangement quality. To confirm the viability of the proposed HA, different arrangements of investigations utilizing LEO satellites, HEO satellites, and a blend of two sorts of satellite missions were structured. An errand size of the trial extending from 25 to 1000 to test the calculation can be very much made arrangements for various situations.

It is clear from the exploratory outcomes that the HA is like other calculation arranging results concerning little scale errands tests. As the undertaking size increments, be that as it may, the HA is better than both the errand income and the assignment culmination rate. The improvement of these arranging results is firmly identified with the expansion of BP neural systems and the upgrades in the hereditary calculations and the neighborhood look calculation. We at that point likewise dissected the impudence of the parameter structure of the hereditary calculation on the exploratory outcomes utilizing the extent of the populace on account of expansive scale undertakings as our investigation of the parameters. The outcomes showed that excessively vast and too little parameter sizes may prompt inadmissible final streamlining results.

Future research ought to consider including increasingly powerful neighborhood look strategies to the calculation. More sorts of information downlink undertakings may likewise turn into a pattern in satellite information downlink booking research. Utilizing satellites to construct Internet of Things merits contemplating. At long last, it is proposed that the utilization of artificial intelligence or machine learning methods for autonomous scheduling arranging might be investigated as a conceivable research region.