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RK Shrivastava
Principal, Dr. Bhagwat Sahay Govt. College, Gwalior, Madhya Pradesh, India

Neha Sharma
Research Scholar, SMS Govt. Model Science College, Gwalior, Madhya Pradesh, India

Corresponding Author:
RK Shrivastava
Principal, Dr. Bhagwat Sahay Govt. College, Gwalior, Madhya Pradesh, India

Spider monkey optimization (SMO): A study and some applications

RK Shrivastava and Neha Sharma

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Abstract
Researchers have recently turned their attention to nature-inspired algorithms that are based on the behaviours of insects, animals, and other creatures. These algorithms have shown promise in solving challenging optimization problems in the real world. The spider monkey optimization (SMO) technique is one of the most well-known algorithms.
SMO and its modified forms have proven effective in addressing certain problems in a variety of computer networking domains, including biomedical, agricultural, and telecommunication. We create spider monkey optimization and its different applications in this study.

Keywords: Spider monkey optimization (SMO), nature inspired algorithm, fission – fusion social behavior, applications of SMO

Introduction
Early human learning was derived from careful study and observation of natural processes. It became clear that the incredibly complex system that is nature tends to converge toward equilibrium. Natural mechanisms serve as the inspiration for the nature-inspired methods known as stochastic approaches.
In 2021, Xia X, *et al.* developed a method for the truck routing problem with stochastic needs which is named as discrete spider monkey optimization.

Basic stages of SMO techniques
In this section we consider the following seven stages of SMO which initialize seven stages of SMO which initialize population of the following stays:
1. Initialize Population
2. Select Local leader
3. Select Global leader
4. Local leader learning phase
5. Global leader learning phase
6. Decision-making phase of Local leaders
7. Decision-making phase of Global leaders

Initialize population
In this step, a set of m spider monkeys are created that are $(i = 1, 2 \ldots \mu)$.
Each monkey is represented by a dimension vector of m components and S_i symbolize the i^{th} spider monkey. The initialization of each dimension j of S_i is given by

$$S_{ij} = S_{\min j} + C_1 (S_{\max j} - S_{\min j}) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Local Leader Stage (LLS): At this point, every spider monkey modifies its stance based on the knowledge it has acquired from this leader learning exercise and the local team members. In place of the earlier one, the spider monkey grabs it.

The spider monkey's equation is as follows:

$$S_{newij} = S_{ij} + C_1\left(LI_{kj} - S_{ij}\right) + C_2\left(S_{rj} - S_{ij}\right) \quad ....(2)$$

$where
S is epresents i^{th} spider monkey S^1S represents j^{th} dimension $LI_k$is the K^{th} Monkey Sr from K^{th} team where $\rho \neq \iota$. αvδ $X_1 \in (0,1)$ $X_2 \in (-1,1)$ be the randomly chosen numbers.

Global Leader Stage (GLS): Upon Completion of previous phase this stage starts. All spider monkeys now reassess their positions based on the gibed leader's and global leader's information.

$$S_{newij} = S_{ij} + C_1\left(G^i_j - S_{ij}\right) + C_2\left(S_{rj} - S_{ij}\right) \quad ....(3)$$

Where
GI_j and symbolizes j^{th} dimension of the stance of global leaders $\varphi \in (1, 2...N)$ is a randomly chosen number. Bansal J. *et al* developed Spider Monkey Optimization Technique in 2012. According to Bansal J. the probability is computed as follows:

$$p_i = 0.9 \times \frac{fit}{\max\ fit} + 0.1 \quad ....(4)$$

1. **Global Leader Learning Stage (GLLS):** Update the Solder Monkey's position at this point by choosing the population's highest fitness using a greedy decision-making process.
2. **Local leader learning stage (LLLS):** The decision approach is used at this point to improve the posture of the local leader.
3. **Local leader decision stage (LLDS)**: All members' postures must be altered, either arbitrarily by the local and global leaders using the following equation, if any local leaders reach the local leader limit (LLL) during this phase.

$$S_{nesij} = S_{ij} + C_1\left(GL_j - S_{ij}\right) + C_2\left(S_{ij} - LI_{kj}\right) \ (5)$$

Global leader decision stage (GLDS): Verify whether or not the global leader's stance has changed at this point.
If the posture of global leader is not updated following a predetermined number of cycles (GLL), then the global leader splits the entire group into smaller units.
In 2023, Deepika Garg *et al.* presented a study of Spider Monkey Optimization: Transformation and its biomedical applications.

Review of Literature
IN 2017, Agrawal N. Jain, S.C. propose first convergence Spider Monkey optimization. In 2019, Essam H., Husain *et al*. explained nature inspired algorithms.
Gupta K. Deep K. J.C. Bansal (2017) [12] Studied Spider Monkey Optimization Method for problems related to optimization.
In 2022, pawar. S. and Ahirwal, M.K. presented a new fission- fusion behavior-based Rao algorithm for solving problem related to optimization. In 2014, Singh A. *et al.* proposed. Cloud computing scheduling technique with load balancing.
In 2022 Huang, X, Lin, Y *et al* studied a gradient based approach for task scheduling problem in cloud computing.
In 2022, Neelkanti A. Reddy eveloepd a hybrid Swarg Intelligence Optimization. Algorithm. In 2023, eepika Gar *et al*. explained a review of spider monkey optimization. In 2024 Gu.D., Ma, Y. discussed a data Dissamination Algorithms based on maximization of Casual path entropy on rehicular a-hoc networks.

Cloud Model
This section explains the scheduling issue in a cloud data centre using models such as task models and scheduling models.

Cloud Model
A single data center or several data centers can provide a comprehensive cloud system. A collection of data centers (D C) with P data centers is used to examine the public cloud system paradigm.

$$\Delta X = \{\delta\chi_1, \delta\chi_2 ... \delta\chi_\pi\}.$$

Each data centre has multiple physical hosts. There are k physical hosts in the data center (dci).

$$\{\pi\eta_{\iota 1}, \pi\eta_{\iota 2}, ... \pi\eta_{\iota\kappa}\}.$$

In the following graph we present the from work of scheduling process in cloud.

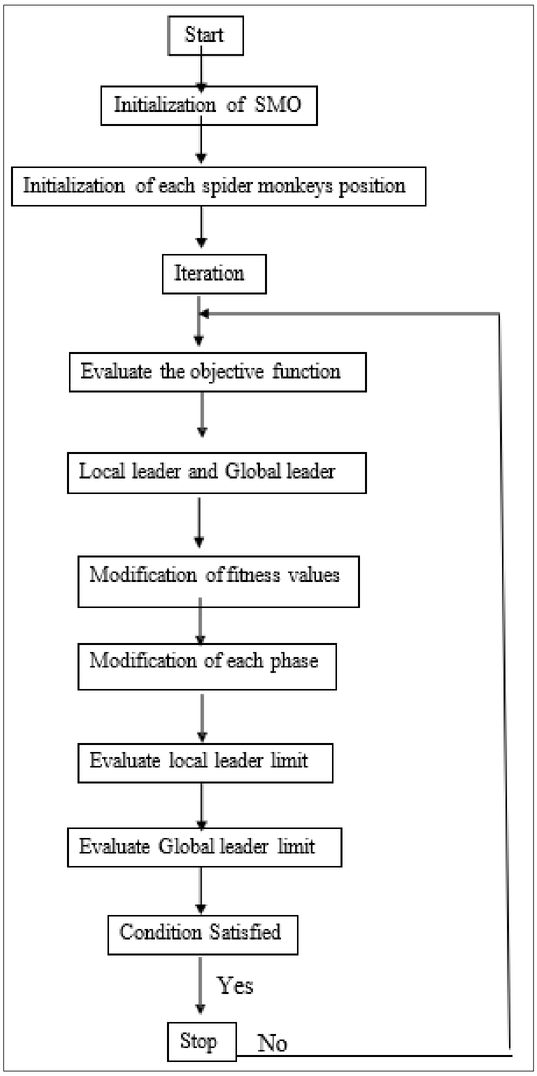

Chart 1: Following is the chart of SMO

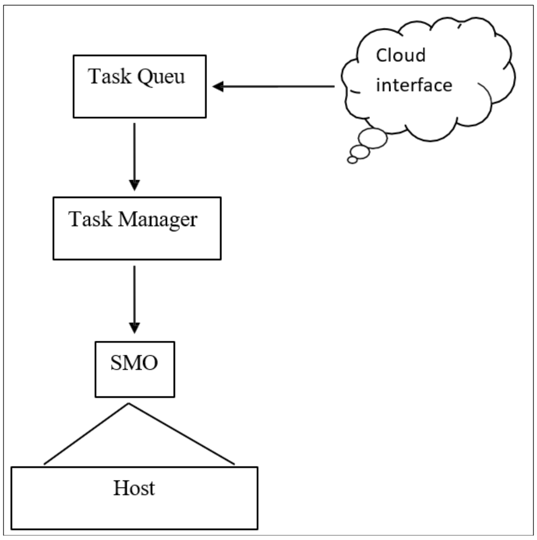

Fig 1: Farm work of scheduling process in cloud

Virtual machine Model (VM)

Every physical host ph has a collection of m virtual systems ie $\{\varsigma\mu_1, \varsigma\mu_2 \ldots \varsigma\mu_\mu\}$. Every Vmi has specific configuration for instance main memory, Vm_{mcm}, Storage etc.

Spider Monkey Optimization (SMO) Inspired Load Balancing

In 2021, Sawson AI Shattnawi and Mohammad Al-Marie described the Spider Monkey Optimization technique for cloud computing load balancing problems. Virtualization technology empowers cloud computing settings by allowing a single processing machine (such a server) to be transformed into a network of virtual machines. A load balancer's job is to map client tasks into virtual machines.

Sawsaon AI Shattanwai and Mohammad Al-Marie considered the load balance issue as well as spider monkeys' food foraging issue, in which users are spider monkeys who must seek for sufficient food sources VMs (virtual machines).

The fundamental idea behind the Spider Monkey Optimization based Load Balancing (SMO-LB) approach is to simulate the dynamic combining and splitting of group members, which is a feature of spider monkey foraging behavior.

Some Applications of Spider Monkey Optimization (SMO)

SMO has many applications in the field of academic and professional areas. Following are the fields where wide range of SMO are to be applied i.e. in the field of telecommunications, electronic and electrical and engineering, computing and networking, biomedical engineering, agriculture, feed and energy etc.

Conclusion

In the present article we have studied spider monkey optimization and its applications. We have discussed basic stages of SMO techniques such as initialize population, Local loader global leaders, and local and global leader learning's, and decision making. We have also explained model and some applications of SMO.

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