

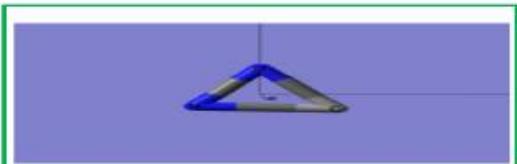


Journal of Applicable Chemistry

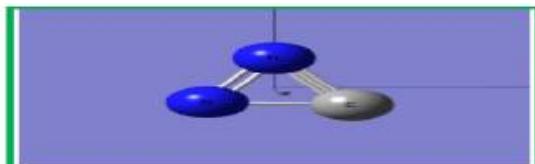
2020, 9 (5): 789-832
(International Peer Reviewed Journal)



New Chemistry News



New News of Chem (NNC)



ChemNewsNew (CNN)

Evolution of Mimics of Algorithms of Nature (E-man)

9. Biology Inspired Methods (Biol. IM)

Information Source	ACS.org ; sciencedirect.com
R. Sambasiva Rao, School of Chemistry, Andhra University, Visakhapatnam 530 003, India	K. Somasekhara Rao, Dept. of Chemistry, Acharya Nagarjuna Univ., Dr. M.R.Appa Rao Campus, Nuzvid-521 201, India

Essential components of Livingorganism

- ☞ Genetic mechanism
 - 📖 Ability to process and transmit heritable information to progeny
- ☞ Metabolic machinery
 - 📖 Ability to capture energy and material resources, staying away from thermodynamic equilibrium
- ☞ Cell membranesystem
 - 📖 Ability to keep its components together and distinguish itself from the environment

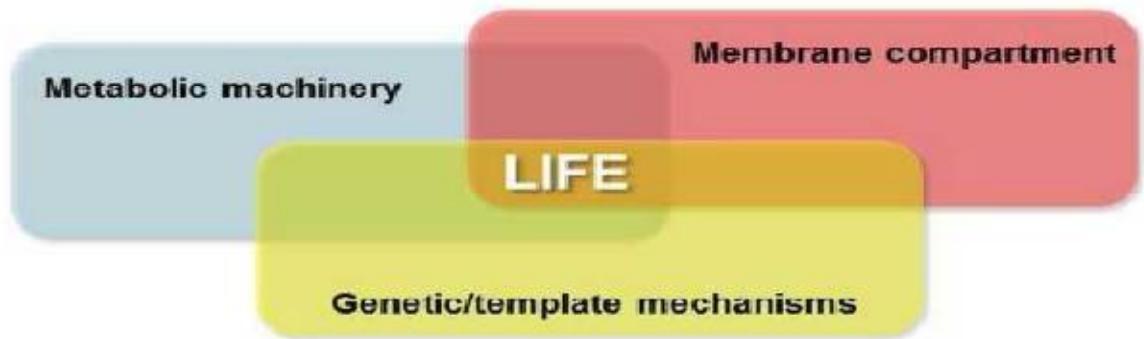
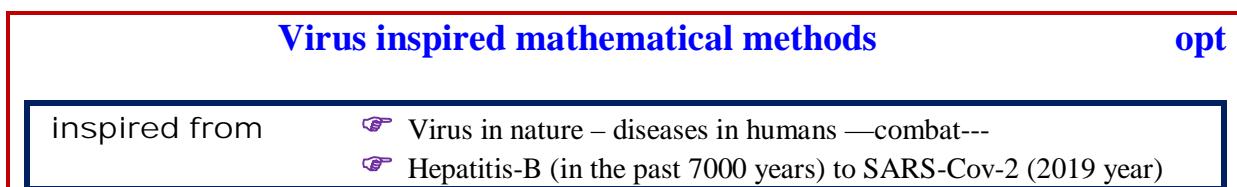
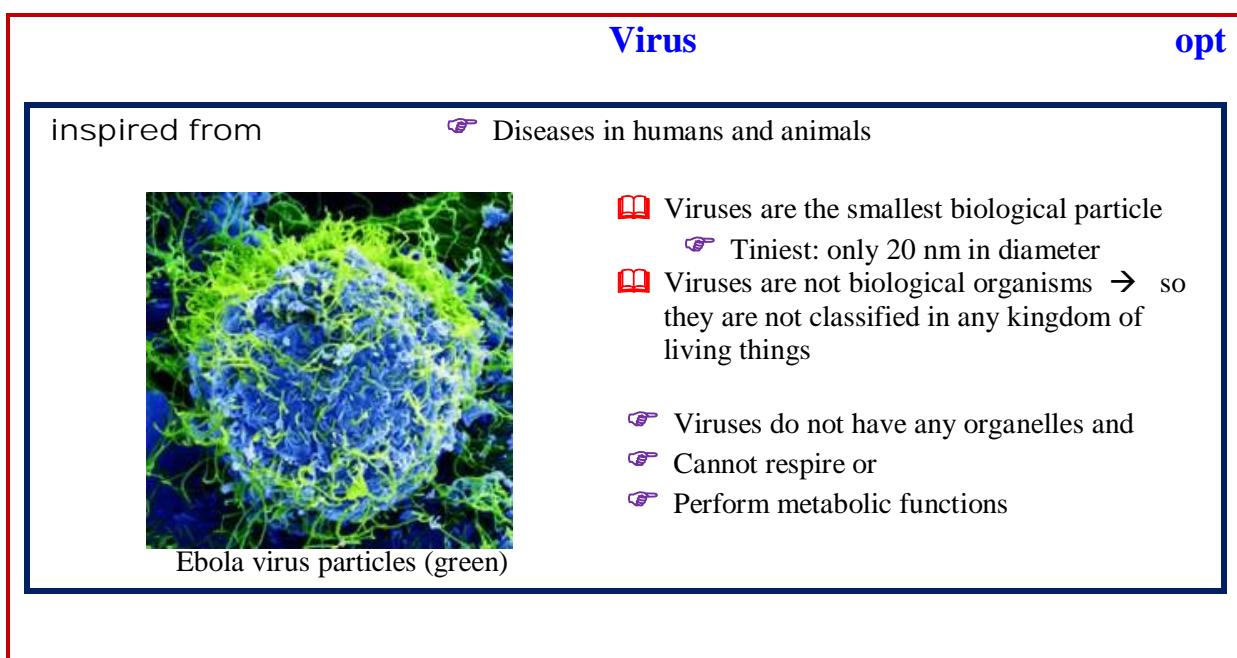


Figure 1. The three main interdependent components of life.

- Joint consideration of these three systems (Figure 1) allows to operationally define living systems as autonomous entities with the capacity for open-ended evolution Chem Rev (2011)-285

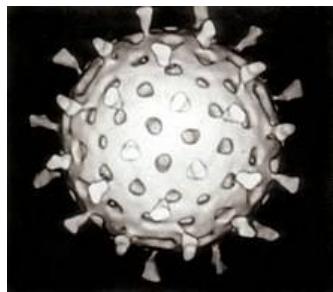


a)	<p>Optimal placement of distributed generators with regard to reliability assessment using virus colony search algorithm</p> <p>International Journal of Renewable Energy Research (2018)</p> <p>Sayed Jamal al-Din Hosseini, Mohammadreza Moradian, Hossein Shahinzadeh, Sima Ahmadi</p>	Title
		Journal
b)	<p>A novel nature-inspired algorithm for optimization: Virus colony search</p>	Title

	Advances in Engineering Software 92 (2016) 65–88, http://dx.doi.org/10.1016/j.advengsoft.2015.11.004	Journal
	MuDongLi, HuiZhao, XingWeiWeng, TongHan	Author(s)
c)	Unit commitment in smart grids with wind farms using virus colony search algorithm and considering adopted bidding strategy	Title
	Smart Grid Conference (SGC) (2017), DOI: 10.1109/SGC.2017.8308892	Journal
	Hossein Shahinzadeh, Gevork B. Gharehpetian, Majid Moazzami, Jalal Moradi, Seyed Hossein Hosseiniyan	Author(s)

Virus & Classification

Rotavirus



Viral classification starts at the level of realm and continues as follows, with the taxonomic suffixes in parentheses

Realm (-vira)

Subrealm (-vira)

Kingdom (-virae)

Subkingdom (-virites)

Phylum (-viricota)

Subphylum (-viricotina)

Class (-viricetes)

Subclass (-viracetidae)

Order (-virales)

Suborder (-virineae)

Family (-viridae)

Subfamily (-virinae)

Genus (-virus)

Subgenus (-virus)

Species

Virus classification

(unranked): Virus

Realm: Riboviria

Kingdom: Orthornavirae

Phylum: Duplornaviricota

Class: Resentoviricetes

Order: Reovirales

Family: Reoviridae

Subfamily: Sedoreovirinae

Genus: **Rotavirus**

Type species

Rotavirus A

Species

- *Rotavirus A*

- *Rotavirus B*

to

- *Rotavirus J*

Energy	[life ; non-life]
Non-life	[Virus]
Life	Biology
Life	[On Earth ; other planets; elsewhere in universe]
Life	[The form humans' now conceive; other forms not yet known [Beliefs; Myths; fiction; Pseudo (false) proofs]]
Biology	[Animal kingdom; Plant kingdom]
[Animal]	[Terrestrial; Marine;Amphibians; Aves;]
[Animal]	[Vertebrates; Invertebrates]
Activities in animal kingdom	[Foraging ; Mating ; Nest (house) selection-- building ; Defense;] [Communication;]
Perception in biology	[Vision; hearing; Touch ; Smell; Taste] [magnetic moment;[dipole;]; electric-signal]
Vision	[Vis; uv; MIRregions]
Sound	[Audible to human; Audible to bat (ultrasonic)]
Smell	[Smell of blood in ocean (whale)]
Magnetic field	Dipole moment (fish)
Charge electrical	Fish (senses voltages)

Animal kingdom

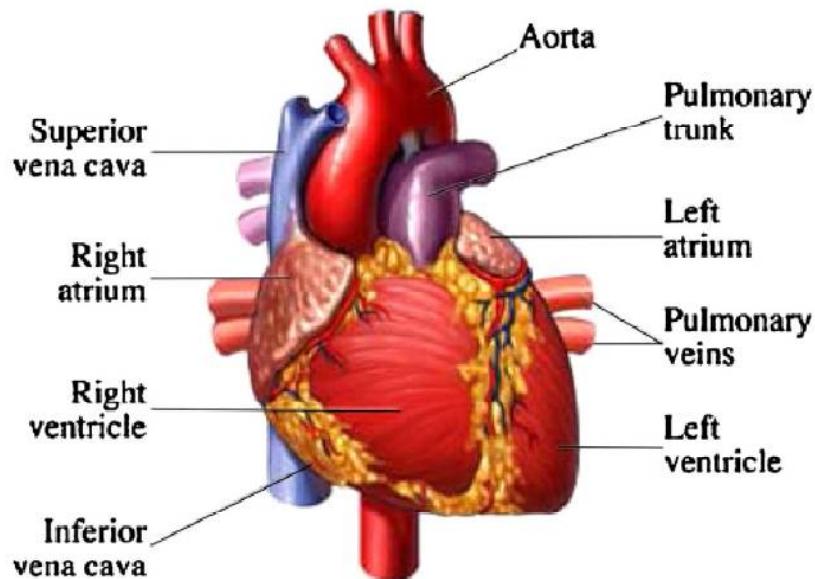
Organs (Human)

Heart

opt

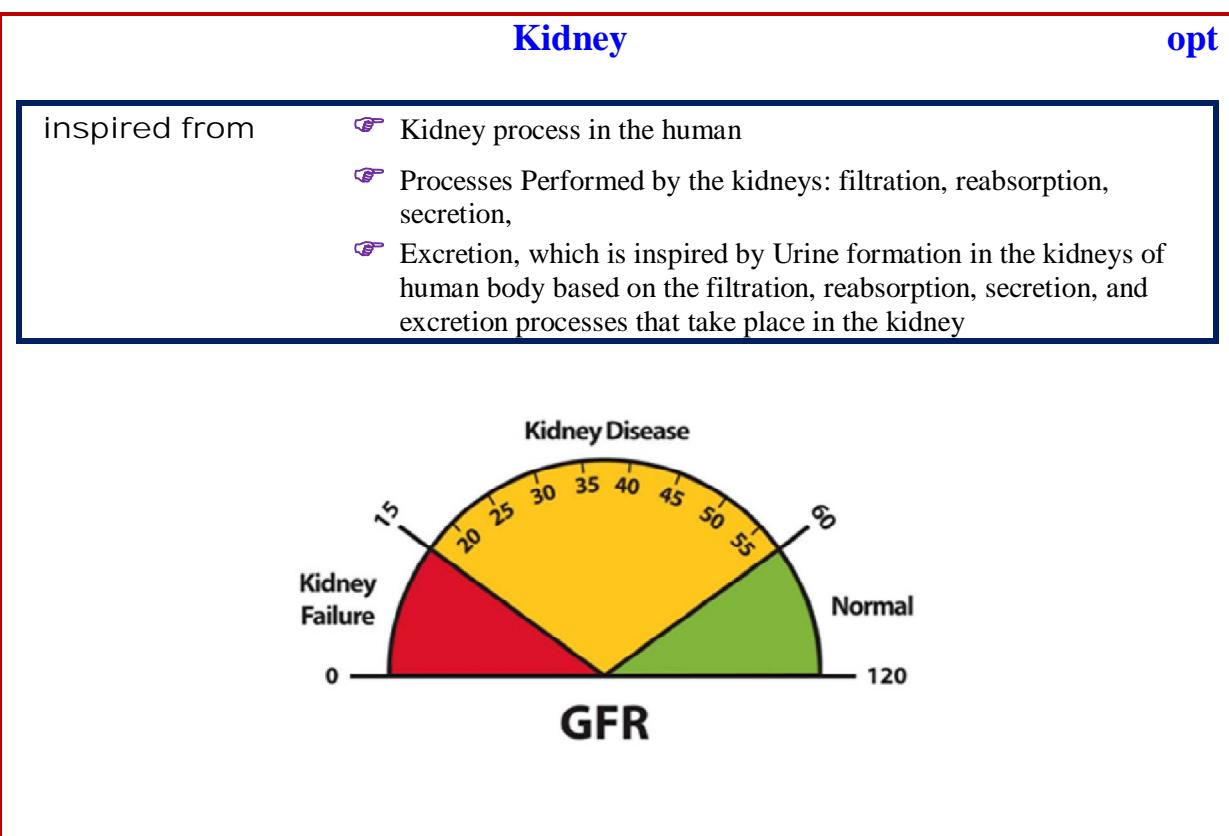
inspired from

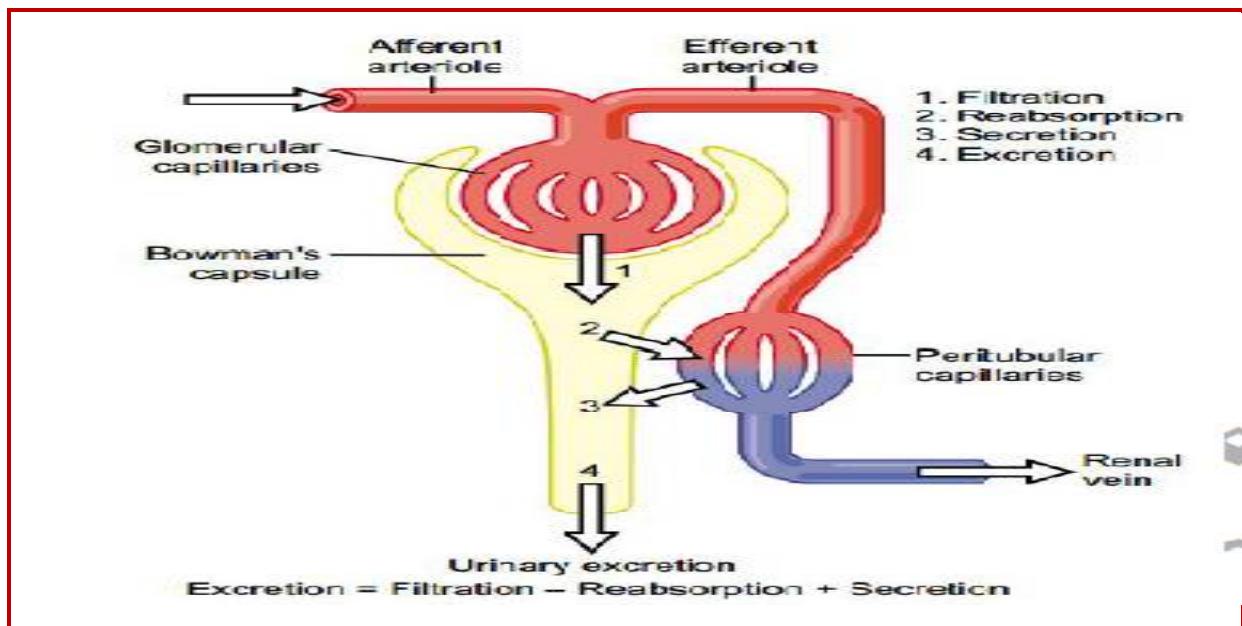
- ☞ Action of the heart and circulatory system in human beings
- ☞ Growth of coronary arteries (veins) in the human heart
- ☞ Circulation of blood in the blood vessels of the heart muscle (myocardium)



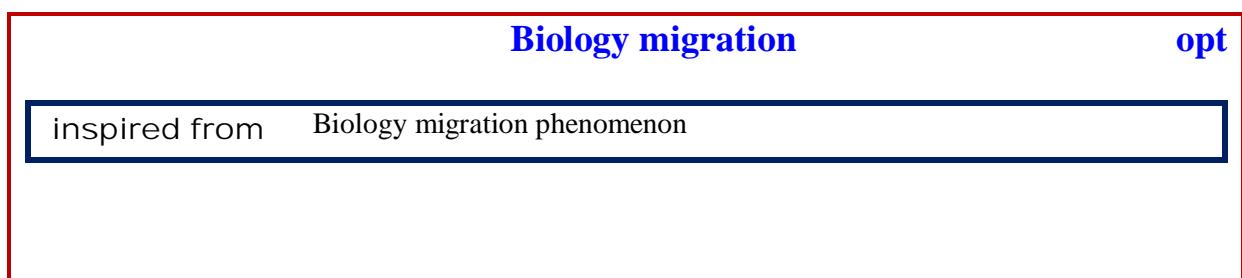
Anatomy of the heart and associated vessels

a)	Heart: a novel optimization algorithm for cluster analysis	Title
	Prog ArtifIntell (2014) 2:167–173, DOI 10.1007/s13748-014-0046-5	Journal
	AbdolrezaHatamlou	Author(s)





a)	Kidney-inspired algorithm for optimization problems Commun Nonlinear Sci NumerSimulat 42 (2017) 358–369, http://dx.doi.org/10.1016/j.cnsns.2016.06.006	Title Journal
	Najmeh Sadat Jaddi, Jafar Alvankarian, Salwani Abdullah	Author(s)
b)	Kidney-inspired algorithm with reduced functionality treatment for classification and time series prediction PLoS ONE 14(1): e0208308. https://doi.org/10.1371/journal.pone.0208308	Title Journal
	Najmeh Sadat Jaddi, Salwani Abdullah	Author(s)
c)	Optimization of neural network using kidney-inspired algorithm with control of filtration rate and chaotic map for real-world rainfall forecasting Engineering Applications of Artificial Intelligence 67 (2018) 246–259, https://doi.org/10.1016/j.engappai.2017.09.012	Title Journal
	Najmeh Sadat Jaddi, Salwani Abdullah	Author(s)





(a)



(b)



(c)



(d)

a Wildebeest

BMAlg. migration process
b Seafowl

c Elephant

d Dolphin

a)	Biology migration algorithm: a new nature-inspired heuristic methodology for global optimization	Title
	Soft Computing (2018), https://doi.org/10.1007/s00500-018-3381-9	Journal
	Qingyang Zhang, Ronggui Wang, Juan Yang, Andrew Lewis, Francisco Chiclana, Shengxiang Yang	Author(s)
b)	Emerging Biology-based CI Algorithms	Title
	Innovative Computational Intelligence:A Rough Guide to 134 Clever Algorithms, Intelligent Systems Reference Library 62,DOI: 10.1007/978-3-319-03404-1_17	Journal
	B. Xing and W.J. Gao,	Author(s)

Terrestrial (biology)

Buffalo African

opt

inspired from Migrant lifestyle of African buffalos

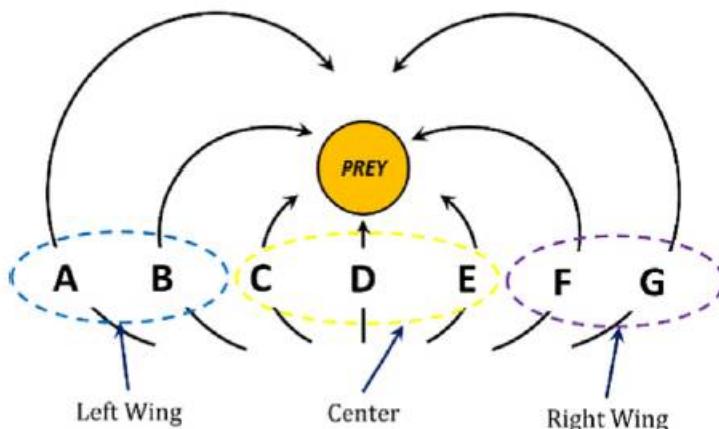
a)	African buffalo optimization for global optimization	Title
	Current Science, VOL. 114, NO. 3, (2018)627-636, doi: 10.18520/cs/v114/i03/627-636	Journal

Lion Swarm

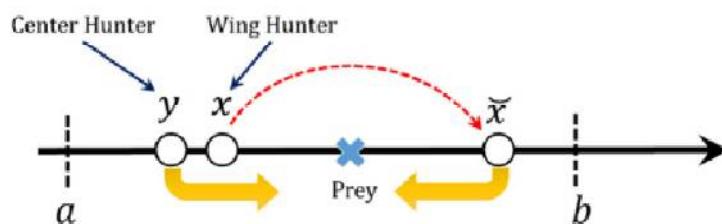
opt

inspired from

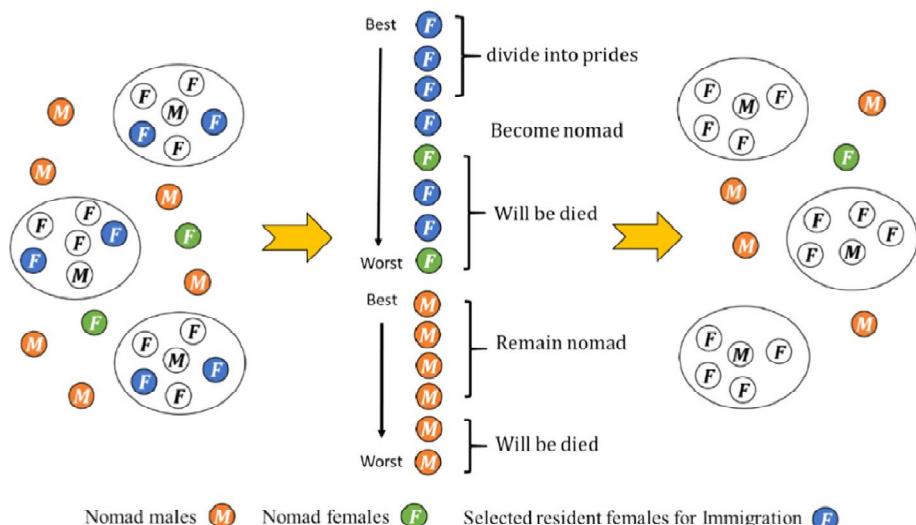
☞ Lion pride; social and sexual life of lions



A schematic of generalized lions hunting behavior



An example of encircling in LOA



Migration and Lions' Population Equilibrium

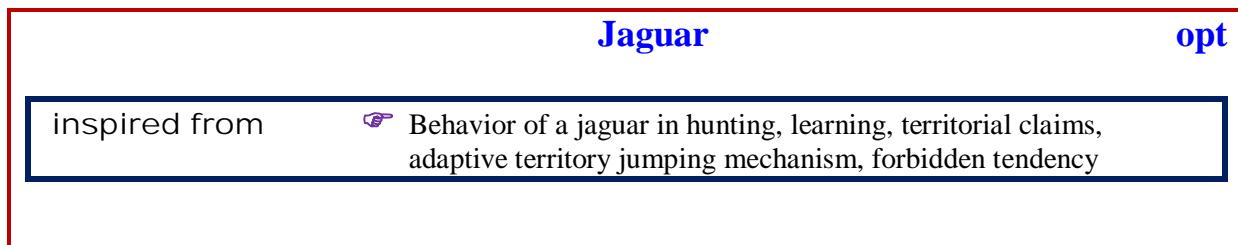
a)

Lion swarm optimization algorithm for comparative study with application to optimal dispatch of cascade hydropower stations

Title

	Applied Soft Computing Journal (2019), https://doi.org/10.1016/j.asoc.2019.105974 .	Journal
	Junfeng Liu, Dingfang Li, Yun Wu, Dedi Liu	Author(s)
b)	The Lion's algorithm: A new nature - Inspired Search Algorithm	Title
	Procedia Technology 6 (2012) 126 – 135	Journal
	B.R.Rajakumar	Author(s)

c)	Lion Optimization Algorithm(LOA):A nature-inspired metaheuristic algorithm Journal of Computational Design and Engineering 3(2016) 24–36, http://dx.doi.org/10.1016/j.jcde.2015.06.003	Title
	Maziar Yazdani, FariborzJolai	Author(s)
d)	Optimization using lion algorithm: a biological inspiration from lion's social behavior Evolutionary Intelligence (2018), https://doi.org/10.1007/s12065-018-0168-y	Title
	RajakumarBoothalingam	Author(s)
e)	Lion Algorithm for Standard and Large Scale Bilinear System Identification: A Global Optimization based on Lion's Social Behavior 2014 IEEE Congress on Evolutionary Computation (CEC) July 6-11, (2014), Beijing, China	Title
	B R Rajakumar	Author(s)



a)	Next Generation Metaheuristic: Jaguar Algorithm IEEE Access, DOI 10.1109/ACCESS.2018.2797059	Title
	Yao-Hsin Chou, Shu-Yu Kuo, Li-Sheng Yang, and Chia-Yun Yang	Author(s)
b)	A Novel Metaheuristic: Jaguar Algorithm with learning behavior 2015 IEEE International Conference on Systems, Man, and Cybernetics, DOI 10.1109/SMC.2015.282	Title
	Chin-Chi Chen, Yung-Che Tsai, I-I Liu, Chia-Chun Lai, Yi-Ting Yeh, Shu-Yu Kuo, Yao-Hsin Chou	Author(s)
c)	Dynamic Multi-dimensional Jaguar Algorithm with Adaptive Step for Optimization Problem 2018 IEEE International Conference on Systems, Man, and Cybernetics, DOI 10.1109/SMC.2018.00268	Title
	Li-Sheng Yang, Chia-Yun Yang, Yu-Chi Jiang, Du-Sing Chang, Shu-Yu Kuo, and Yao-Hsin Chou	Author(s)

Hyena Spotted

opt

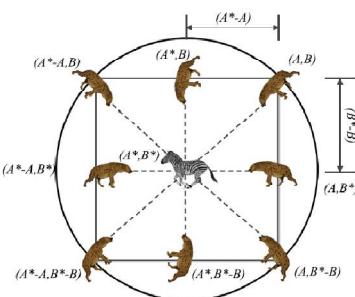
inspired from

- ☞ Social hierarchy of spotted hyena
- ☞ Prey capture process (i.e., including encircling/ hunting / attacking prey)

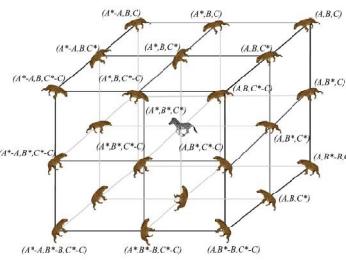
<i>Animalia</i>	<i>Tetrapoda Class</i>	<i>Mammalia</i>
Kingdom	Class	Subclass
<i>Crocuta crocata</i>	<i>Carnivora</i>	<i>Hyaenidae</i>
Species	Suborder	Family



Hunting behavior of spotted hyenas: (A) searching and tracking prey (B) Chasing (C) Troublesome and encircling (D) Immobile situation and attack prey



2D position vectors of spotted hyena.



3D position vectors and possible next locations of spotted hyena



Searching prey ($|E| > 1$).

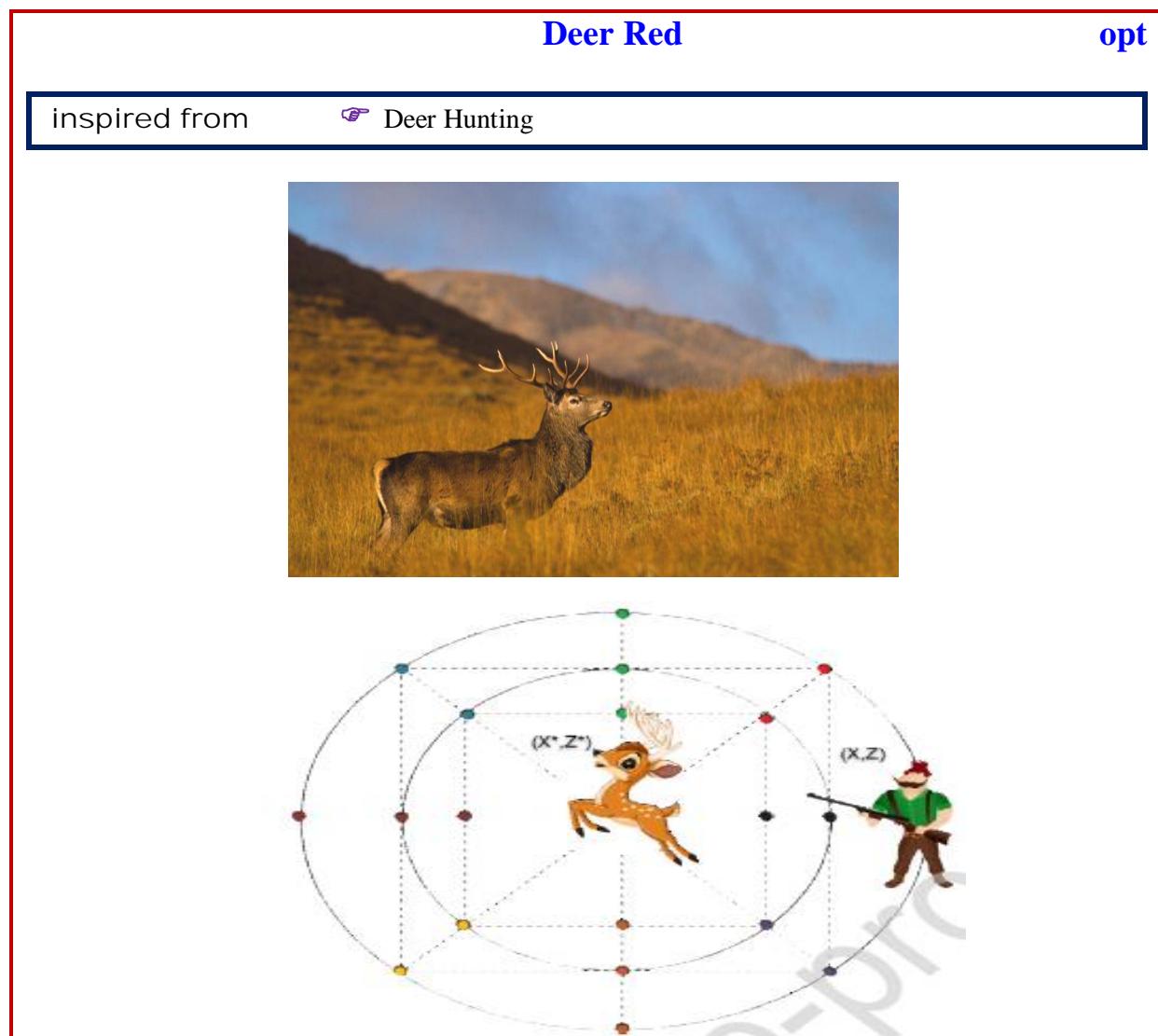
a)	Using Spotted Hyena Optimizer for Training FNN (Feedforward Neural Networks) ICIC 2018, LNAI 10956, (2018) 1–6, https://doi.org/10.1007/978-3-319-95957-3_88	Title Journal
	Jie Li, Qifang Luo, Ling Liao and Yongquan Zhou	Author(s)
b)	Spotted hyena optimizer: A novel bio-inspired based metaheuristic technique for engineering applications Advances in Engineering Software 0 0 0 (2017) 1–23, http://dx.doi.org/10.1016/j.advengsoft.2017.05.014	Title Journal
	Gaurav Dhiman, Vijay Kumar	Author(s)

c)	Binary spotted hyena optimizer and its application to feature selection Journal of Ambient Intelligence and Humanized Computing (2019), https://doi.org/10.1007/s12652-019-01324-z	Title Journal
	Vijay Kumar, Avneet Kaur	Author(s)
d)	Spotted Hyena Optimizer for Solving Engineering Design Problems 2017 International Conference on Machine learning and Data Science, DOI 10.1109/MLDS.2017.5	Title Journal
	Gaurav Dhiman, Amandeep Kaur	Author(s)

a)	Multi-objective spotted hyena optimizer: A Multi-objective optimization algorithm for engineering problems Knowledge-Based Systems 150 (2018) 175–197, https://doi.org/10.1016/j.knosys.2018.03.011	Title Journal
	Gaurav Dhiman, Vijay Kumar	Author(s)
b)	Improved spotted hyena optimizer with space transformational search for training pi-sigma higher order neural network	Title

Computational Intelligence (2020) 1–31. DOI: 10.1111/coin.12272 Journal
Nibedan Panda, Santosh Kumar Majhi Author(s)

c)	<p>Oppositional spotted hyena optimizer with mutation operator for global optimization and application in training wavelet neural network</p> <p>Journal of Intelligent & Fuzzy Systems (2020), DOI:10.3233/JIFS-179746</p> <p>Nibedan Panda, Santosh Kumar Majhi, Sarishma Singh and Abhirup Khanna</p>	Title
		Journal
		Author(s)

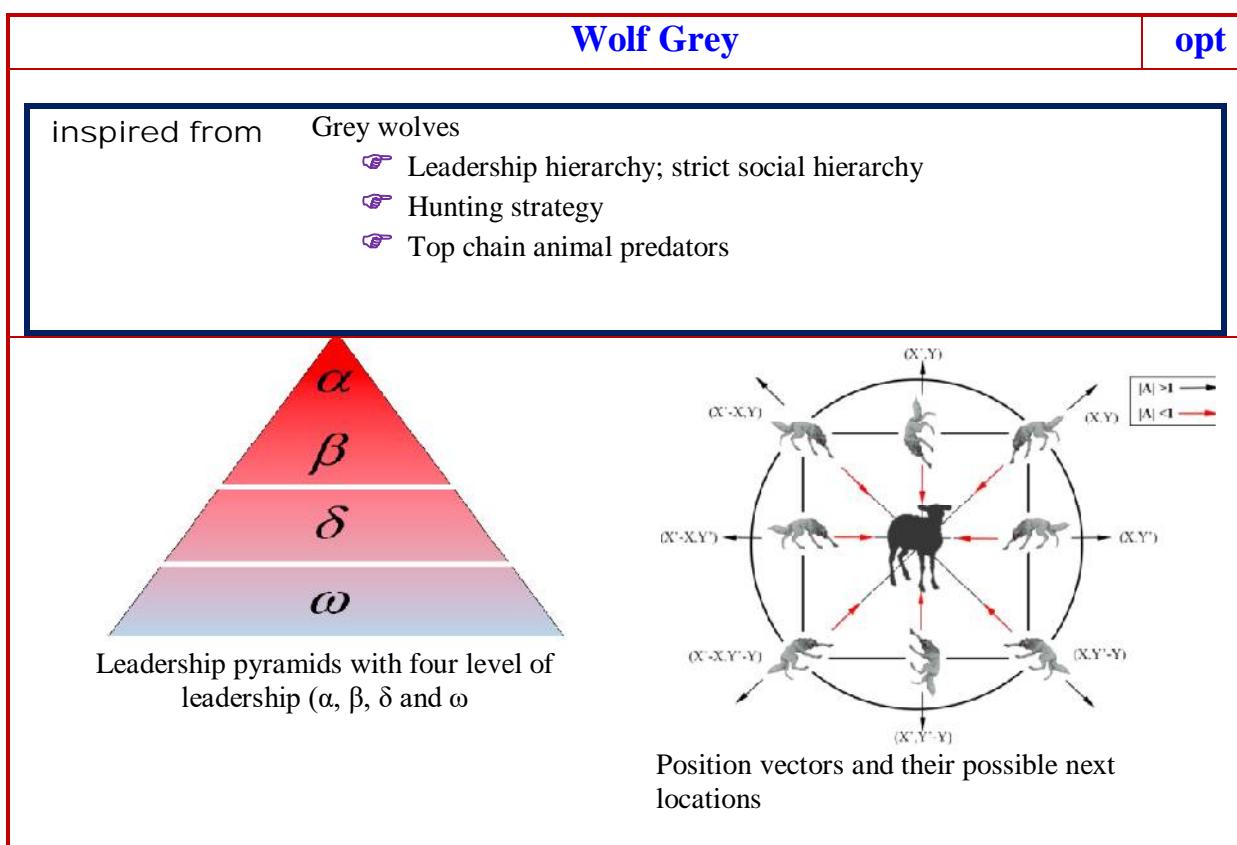


a)	Deer Hunting Optimization Algorithm: A New Nature-Inspired Meta-heuristic Paradigm SECTION A: COMPUTER SCIENCE THEORY, METHODS AND TOOLS THE COMPUTER JOURNAL, (2018)	Title Journal
	G. Brammya, S. Praveena, N.S. Ninupreetha, R. Ramya, B.R. Rajakumar and D. Binu	Author(s)

b)	New Optimal Design for a Hybrid Solar Chimney, Solid Oxide Electrolysis and Fuel Cell based on Improved Deer hunting optimization algorithm	Title
	Journal of Cleaner Production (2019), https://doi.org/10.1016/j.jclepro.2019.119414	Journal
	Man-Wen Tian, Shu-Rong Yan, Shi-Zhuan Han, Sayyad Nojavan, KittisakJermitsittiparsert, NavidRazmjooy	Author(s)

c)	Red deer algorithm (RDA): a new nature-inspired meta-heuristic	Title
	Soft Computing, (2020), https://doi.org/10.1007/s00500-020-04812-z	Journal
	Amir Mohammad Fathollahi-Fard, Mostafa Hajiaghaei-Keshteli, Reza Tavakkoli-Moghaddam	Author(s)

d)	Red deer algorithm (RDA); a new optimization algorithm inspired by red deer's mating	Title
	International Conference on Industrial Engineering (ICIE 2016)	Journal
	A. M. FathollahiFard, M. Hajiaghaei-Keshteli	Author(s)



a)	Efficient boosted grey wolf optimizers for global search and kernel extreme learning machine training	Title
	Applied Soft Computing Journal, 81 (2019) 105521, https://doi.org/10.1016/j.asoc.2019.105521	Journal
	Ali Asghar Heidari, Rahim Ali Abbaspour, Huiling Chen	Author(s)

b)	Evolving an optimal kernel extreme learning machine by using an enhanced grey wolf optimization strategy	Title
	Expert Systems With Applications 138 (2019) 112814, https://doi.org/10.1016/j.eswa.2019.07.031	Journal
	Zhennao Cai, Jianhua Gu, Jie Luo, Qian Zhang, Huiling Chen b, Zhifang Pan, Yuping Li, Chengye Li	Author(s)

c)	Effective parameters' identification for polymer electrolyte membrane fuel cell models using grey wolf optimizer	Title
	Renewable Energy 111 (2017) 455-462, http://dx.doi.org/10.1016/j.renene.2017.04.036	Journal
	M. Ali, M.A. El-Hameed MIEEE, M.A. Farahat	Author(s)
d)	A novel hybrid GWO-SCA approach for optimization problems	Title
	Engineering Science and Technology, an International Journal (2017), https://doi.org/10.1016/j.jestch.2017.11.001	Journal
	N. Singh, S.B. Singh	Author(s)
e)	β -Chaotic map enabled Grey Wolf Optimizer	Title
	Applied Soft Computing Journal 75 (2019) 84–105, https://doi.org/10.1016/j.asoc.2018.10.044	Journal
	Akash Saxena, Rajesh Kumar, Swagatam Das	Author(s)
f)	An optimal programming among renewable energy resources and storage devices for responsive load integration in residential applications using hybrid of grey wolf and shark smell algorithms	Title
	Journal of Energy Storage 27 (2020) 101126, https://doi.org/10.1016/j.est.2019.101126	Journal
	Amir Seifi, Mohammad H. Moradi, Mohamad Abedini, Alireza Jahangiri	Author(s)

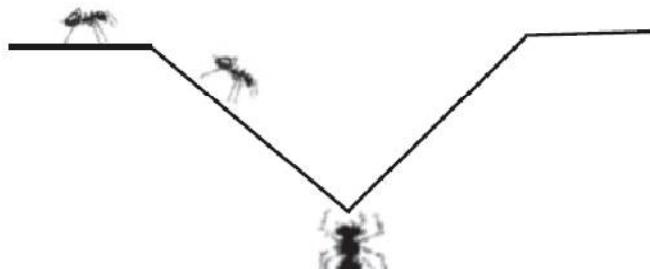
a)	Algorithm of Marriage in Honey Bees Optimization Based on the Wolf Pack Search	Title
	2007 International Conference on Intelligent Pervasive Computing, DOI 10.1109/IPC.2007.104	Journal
	Chenguang Yang, Xuyan Tu, Jie Chen	Author(s)
b)	Hybrid Optimization Algorithm Based on Wolf Pack Search and Local Search for Solving Traveling Salesman Problem	Title
	J. Shanghai Jiao Tong Univ. (Sci.), 2019, 24(1): 41-47, https://doi.org/10.1007/s12204-019-2039-9	Journal
	DONG Ruyi, WANG Shengsheng, WANG Guangyao, WANG Xinying	Author(s)

c)	Improved Particle Swarm Optimization Using Wolf Pack Search	Title
	IOP Conf. Series: Journal of Physics: Conf. Series 1176 (2019) 052009, doi:10.1088/1742-6596/1176/5/052009	Journal
	Hao-ran Chen, Li-jie Cui, Qing Guo, Jia-kui Zhang	Author(s)
d)	Wolf Pack Algorithm for Unconstrained Global Optimization	Title
	Mathematical Problems in Engineering (2014), Article ID 465082, http://dx.doi.org/10.1155/2014/465082	Journal
	Hu-Sheng Wu and Feng-Ming Zhang	Author(s)
e)	A novel reinforcement learning based grey wolf optimizer algorithm for unmanned aerial vehicles (UAVs) path planning	Title

Applied Soft Computing Journal (2020), https://doi.org/10.1016/j.asoc.2020.106099 .	Journal
Chengzhi Qu, Wendong Gai, Maiying Zhong, Jing Zhang	Author(s)

..... Insects

Ant Lion opt

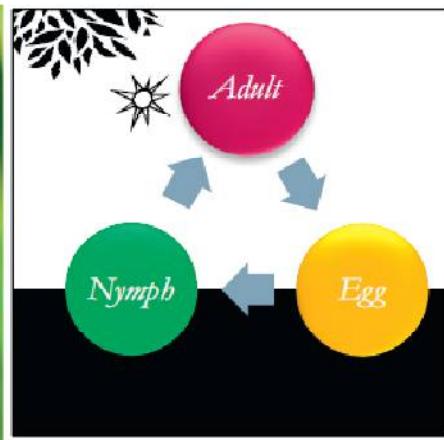
inspired from	<ul style="list-style-type: none"> ✓ Hunting mechanism of antlions in nature ✓ Sit-and-pursue foraging
<i>Animalia</i> <i>Insecta</i> <i>order Neuroptera</i> Kingdom Class Order Myrmeleon Myrmeleontidae Genus Family	
 Antlion pit with antlion sitting at bottom	

a)	Improved antlion optimization algorithm via tournament selection and its application to parallel machine scheduling Computers & Industrial Engineering , 132 (2019) 166–186, HaydarKılıç, UğurYüzgec	Title Journal Author(s)
b)	Feature Selection via Chaotic Antlion Optimization PLOS ONE , (2016) 1-21, DOI:10.1371/journal.pone.0150652 Hossam M. Zawbaa, E. Emamy, CrinaGrosan	Title Journal Author(s)
c)	Spider and Antlion Foraging Algorithms Natural Computing Series (2018), https://doi.org/10.1007/978-3-319-59156-8_12 A. Brabazon, S. McGarragh	Title Journal Author(s)

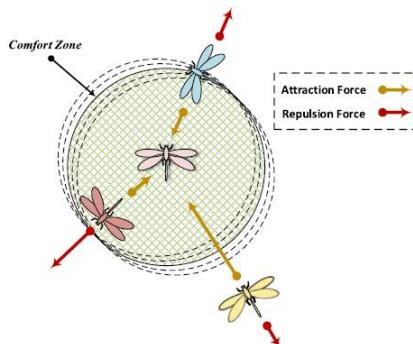
Grasshopper opt

inspired from

☞ Swarming behavior of grasshoppers in nature (jumping insect)



(a) Real grasshopper (b) Life cycle of grasshoppers (left image courtesy of Mehrdad Momeny).



a)	Binary grasshopper optimisation algorithm approaches for feature selection problems Expert Systems With Applications 117 (2019) 267–286, https://doi.org/10.1016/j.eswa.2018.09.015	Title Journal
	MajdiMafarja, Ibrahim Aljarah, Hossam Faris, Abdelaziz I. Hammouri, Ala M. Al-Zoubi, SeyedaliMirjalili	Author(s)

b)	Grasshopper Optimisation Algorithm: Theory and application Advances in Engineering Software 105 (2017) 30–47, http://dx.doi.org/10.1016/j.advengsoft.2017.01.004	Title Journal
	ShahrzadSaremi, SeyedaliMirjalili, Andrew Lewis	Author(s)
c)	A new binary grasshopper optimization algorithm for feature selection problem Journal of King Saud University – Computer and Information Sciences (2019), https://doi.org/10.1016/j.jksuci.2019.11.007	Title Journal
	HaouassiHichem, Merah Elkamel, Mehdaoui Rafik, MaaroukToufikMesaaoud, ChouhalOuahiba	Author(s)

Longhorn beetle

opt

inspired from

☞ Search behavior with long antennae



(a)

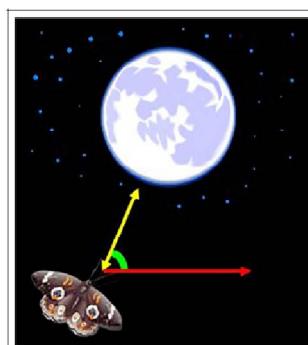
a)	BSAS:Beetle Swarm Antennae Search Algorithmfor Optimization Problems arXiv:1807.10470v1 (2018) Jiangyu Wang, Huanxin Chen	Title Journal Author(s)
b)	Beetle Swarm Optimization Algorithm:Theory and Application Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx Tiantian Wang , Long Yang , Qiang Liu	Title Journal Author(s)
c)	Pity beetle algorithm – A new metaheuristic inspired by the behavior of bark beetles Advances in Engineering Software 121 (2018) 147–166, https://doi.org/10.1016/j.advengsoft.2018.04.007	Title Journal Author(s)

Moth Flame

opt

inspired from

Motion of moths around fire/light in nature



Transverse orientation of moth flame

a)	Binary Moth Search Algorithm for Discounted {0-1} Knapsack Problem	Title
----	--------------------------------------------------------------------	-------

	Access (2018), DOI: 10.1109/ACCESS.2018.2809445 YAN-HONG FENG1 AND GAI-GE WANG	Journal Author(s)
b)	Enhanced Moth-flame optimizer with mutation strategy for global optimization Information Sciences 492 (2019) 181–203, https://doi.org/10.1016/j.ins.2019.04.022 Yueting Xu, Huiling Chen, Jie Luo, Qian Zhang, Shan Jiao, Xiaoqin Zhang	Title Journal Author(s)
c)	Intelligent clustering using moth flame optimizer for vehicular ad hoc networks International Journal of Distributed Sensor Networks, (2019), Vol. 15(1) DOI: 10.1177/1550147718824460 Atif Ishtiaq, Sheeraz Ahmed, Muhammad Fahad Khan, Farhan Aadil, Muazzam Maqsood and Salabat Khan	Title Journal Author(s)

d)	Moth search algorithm: a bio-inspired metaheuristic algorithm for global optimization problems Memetic Comp. (2016), DOI 10.1007/s12293-016-0212-3 Gai-Ge Wang	Title Journal Author(s)
e)	An improved moth-flame optimization algorithm for support vectormachine prediction of photovoltaic power generation Journal of Cleaner Production (2020), https://doi.org/10.1016/j.jclepro.2020.119966 Guo-Qian Lin, Ling-Ling Li, Ming-Lang Tseng, Han-Min Liu, Dong-Dong Yuan, Raymond R. Tan	Title Journal Author(s)

Bees

Inspired by	<ul style="list-style-type: none"> ☞ Foraging of honey bee ☞ Mating of honey bees ☞ Hive site selection
-------------	------------------------------------------------------------------------------------------------------------------------------------------

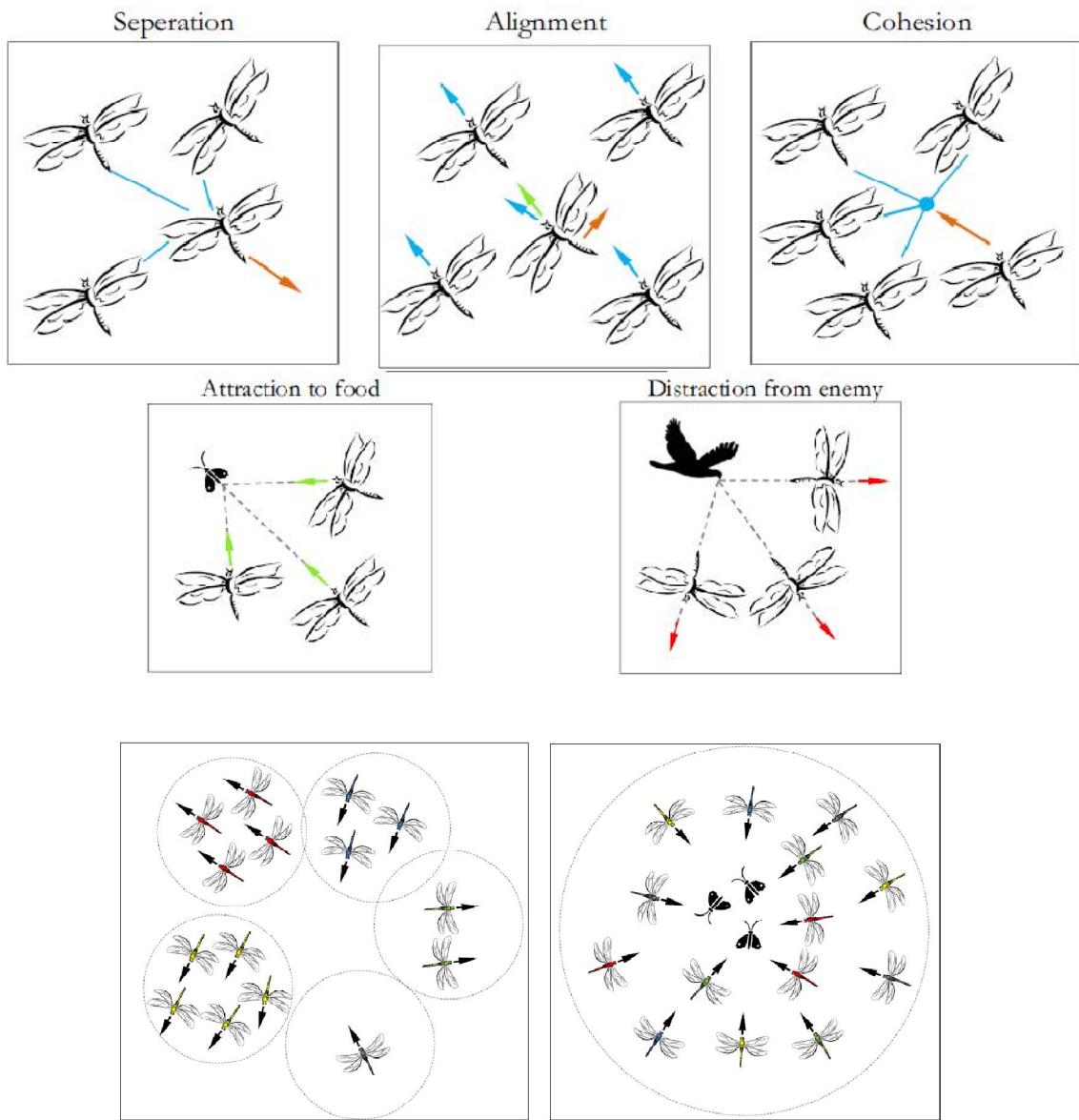
Dragon Fly

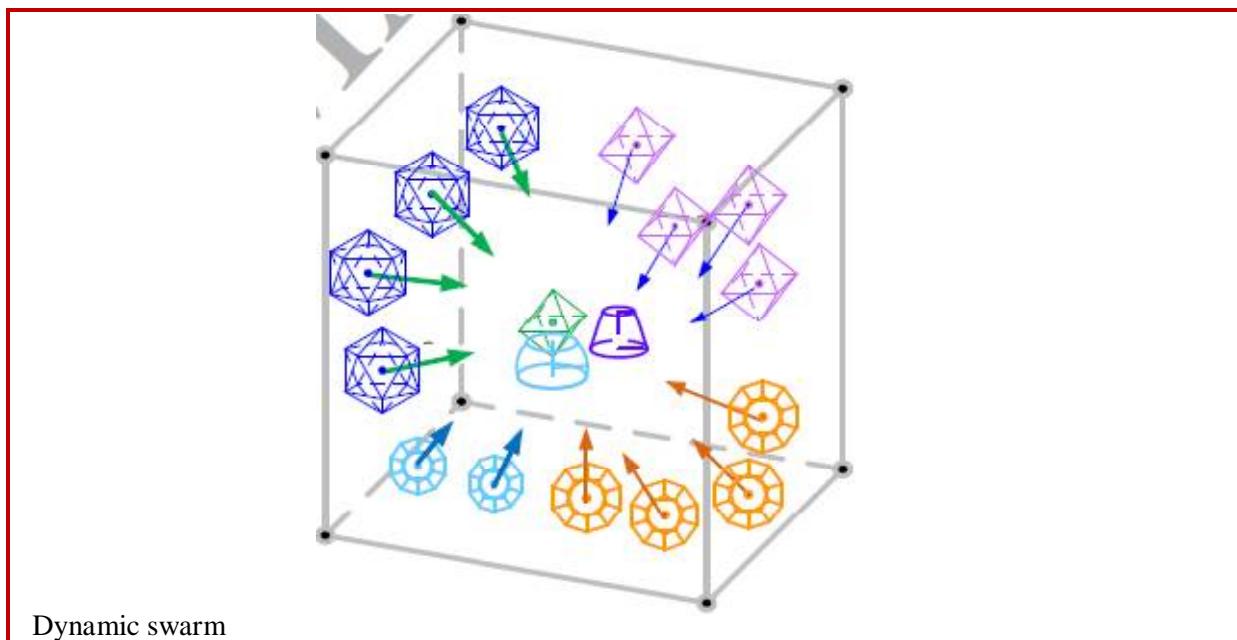
opt

inspired from Hunting and migration mechanisms of dragonflies

<i>Animalia</i>	<i>Insecta</i>	<i>Odonata</i>
Kingdom	Class	Order
<i>Carnivore</i>	<i>Arthropoda</i>	<i>Anisoptera</i>
Diet	Phylum	Scientific name

<i>Mosquitoes, Fly, Bee</i>	<i>Birds, Fish, Lizards</i>
Prey	Predators





a)	<p>Binary Dragonfly Optimization for Feature Selection using Time-Varying Transfer functions Knowledge-Based Systems (2018), https://doi.org/10.1016/j.knosys.2018.08.003</p> <p>MajdiMafarja, Ibrahim Aljarah, Ali Asghar Heidari, Hossam Faris, Philippe Fournier-Viger, Xiaodong Li, SeyedaliMirjalili</p>	Title Journal Author(s)
b)	<p>Hybrid Nelder–Mead Algorithm and Dragonfly Algorithm for Function Optimization and the Training of a Multilayer Perceptron Arabian Journal for Science and Engineering (2018), https://doi.org/10.1007/s13369-018-3536-0</p> <p>Jianzhong Xu, Fu Yan</p>	Title Journal Author(s)
c)	<p>Improved binary dragonfly optimization algorithm and wavelet packet based non-linear features for infant cry classification Computer Methods and Programs in Biomedicine, 155 (2018) 39–51, https://doi.org/10.1016/j.cmpb.2017.11.021</p> <p>M. Hariharan, R. Sindhu, VikneswaranVijean, Haniza Yazid, ThiagarNadarajaw, Sazali Yaacob, Kemal Polat</p>	Title Journal Author(s)
d)	<p>Power flow management in micro grid through renewable energy sources using a hybrid modified dragonfly algorithm with bat search algorithm Energy, 181 (2019) 1166-1178, https://doi.org/10.1016/j.energy.2019.06.029</p> <p>K. Sureshkumar, Vijayakumar Ponnusamy</p>	Title Journal Author(s)
e)	<p>A Multi-Level Thresholding Method for Breast Thermograms Analysis using Dragonfly Algorithm Infrared Physics & Technology (2018), https://doi.org/10.1016/j.infrared.2018.08.007</p> <p>Margarita-Arimatea Díaz Cortés, Noé Ortega-Sánchez, Salvador Hinojosa, Diego Oliva, Erik Cuevas, Raúl Rojas, Anton Demin</p>	Title Journal Author(s)

f)	Wind-Solar-Hydro power optimal scheduling model based on multi objective dragonfly algorithm Energy Procedia 158 (2019) 6217–6224, doi: 10.1016/j.egypro.2019.01.476 Jie Li, Jiantao Lu, Liqiang Yao, Liangge Cheng, Hui Qin	Title Journal Author(s)
g)	Memory based Hybrid Dragonfly Algorithm for numerical optimization problems Expert Systems With Applications 83 (2017) 63–78, http://dx.doi.org/10.1016/j.eswa.2017.04.033 SreeRanjini K.S and S. Murugan	Title Journal Author(s)

h)	Dragonfly algorithm: a new meta-heuristic optimization technique for solving single-objective, discrete, and multi-objective problems Neural Comput&Applic (2015), DOI 10.1007/s00521-015-1920-1 SeyedaliMirjalili	Title Journal Author(s)
i)	A Modified Dragonfly Optimization Algorithm for Single- and Multi-objective Problems Using Brownian Motion Computational Intelligence and Neuroscience (2019), Article ID 6871298, https://doi.org/10.1155/2019/6871298 ÇigdemInanAcı and HakanGulcan	Title Journal Author(s)

j)	Dragonfly Algorithm and Its Applications in Applied Science Survey Computational Intelligence and Neuroscience (2019), Article ID 9293617, https://doi.org/10.1155/2019/9293617	Title Journal
k)	Chnoor M. Rahman and Tarik A. Rashid	Author(s)
l)	Dragonfly algorithm: a comprehensive review and applications Neural Computing and Applications (2020), https://doi.org/10.1007/s00521-020-04866-y	Title Journal
	Yassine Meraihi, Amar Ramdane-Cherif, Dalila Acheli, Mohammed Mahseur	Author(s)
	Self-adaptive dragonfly based optimal thresholding for multilevel segmentation of digital images Journal of King Saud University – Computer and Information Sciences (2018) 30, 449–461, http://dx.doi.org/10.1016/j.jksuci.2016.11.002	Title Journal
	Rakoth Kandan Sambandam, Sasikala Jayaraman	Author(s)



Ladybird seven-spot—

opt

insect

inspired from

 Foraging behavior of a seven-spot ladybird

-  Trivial behavior of birds like pigeons searching for food
-  Lifestyle of hoopoe family of birds
-  Foraging process of hummingbirds
-  Mating strategies of bird species



Seven-spot ladybird.

a)	Seven-Spot Ladybird Optimization: A Novel and Efficient Metaheuristic Algorithm for Numerical Optimization	Title
	The Scientific World Journal (2013), Article ID 378515, http://dx.doi.org/10.1155/2013/378515	Journal
	Peng Wang, Zhouquan Zhu, and Shuai Huang	Author(s)
b)	Seven-spot Ladybird Optimization Algorithm Based on Bionics Principle	Title
	2017 International Conference on Computer Network, Electronic and Automation, IEEE DOI 10.1109/ICCNEA.2017.23	Journal
	WEI Feng-Tao, ZHENG Jian-Ming	Author(s)

c)	A New Meta-Heuristic Technique for Engineering Design Optimization: Seven-Spot Ladybird Algorithm	Title
	2nd International Symposium on Computer, Communication, Control and Automation (3CA 2013)	Journal
	Peng Wang, Zhouquan Zhu, Shuai Huang	Author(s)
d)	MR-MOSLO: VM Consolidation Using Multiple Regression Multi-Objective Seven-Spot Ladybird Optimization for Host Overload Detection	Title
	International Journal of Intelligent Engineering and Systems, Vol.13, No.2, (2020), DOI: 10.22266/ijies2020.0430.03	Journal
	Akram Saeed AqlanAlhammadi, VasanthiVaradharajan	Author(s)

Spiders

Female Black Widow spider

opt

inspired from

 Unique mating behavior of black widow spiders.

 Exclusive stage, i.e., cannibalism eating male partner

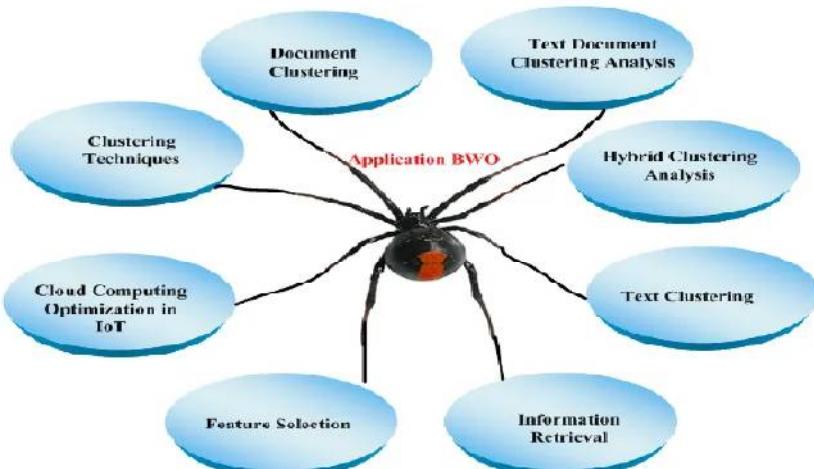
- ❑ Foraging behaviours of social spiders
- ❑ Elite opposition-based learning strategy



a) Female Black Widow on Her Web (b) Female Black Widow with Her Egg Sac on Her Web



Baby spiders leave their Egg Sac



Applications of BWO Algorithm

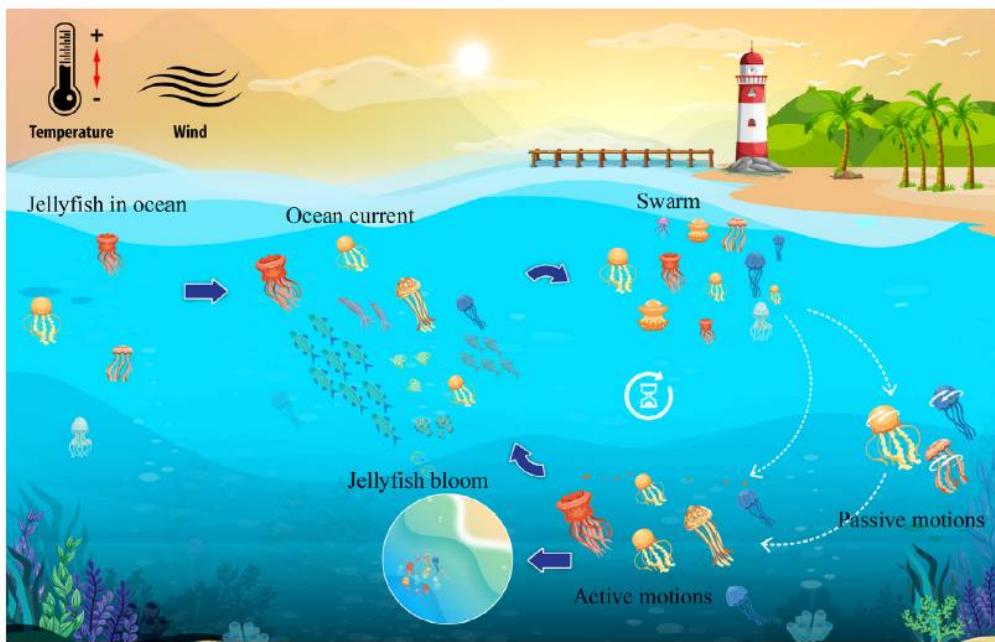
- ❑ Spiders belong to the Class Arachnida,
- ❑ Insects to the Class Insecta.
- ❑ Arachnids are as distant from insects, as birds are from fish
- ❑ It really is not a trivial distinction!

a)	Black Widow Optimization Algorithm: A novel meta-heuristic approach for solving engineering optimization problems	Title
----	-------------------------------------------------------------------------------------------------------------------	-------

	Engineering Applications of Artificial Intelligence, 87 (2020) 103249, https://doi.org/10.1016/j.engappai.2019.103249	Journal
	VahidehHayyolalam, Ali Asghar Pourhaji Kazem	Author(s)
b)	Novel quantum inspired approaches for automatic clustering of gray level images using Particle Swarm Optimization, Spider Monkey Optimization and Ageist Spider Monkey Optimization algorithms	Title
	Soft Computing Journal (2019), https://doi.org/10.1016/j.asoc.2019.106040 .	Journal
	Alokananda Dey, Sandip Dey, Siddhartha Bhattacharyya, Jan Platos, Vaclav Snasel	Author(s)
c)	A Binary Social Spider Optimization Algorithm for Unsupervised Band Selection in Compressed Hyperspectral Images Expert Systems With Applications (2017) , doi: 10.1016/j.eswa.2017.12.034	Title Journal
	Urvashi Prakash Shukla, Satyasai Jagannath Nanda	Author(s)
d)	Elite Opposition-Based Social Spider Optimization Algorithm for Global Function Optimization Algorithms (2017) , 10, 9; doi:10.3390/a10010009	Title Journal
	Ruxin Zhao, Qifang Luo and Yongquan Zhou	Author(s)
e)	Social spiders optimization and flower pollination algorithm for multilevel image thresholding: A performance study Expert Systems With Applications (2016) , http://dx.doi.org/10.1016/j.eswa.2016.02.024	Title Journal
	SalimaOuadfel, ,AbdelmalikTaleb-Ahmed	Author(s)

Marine (biology)

Jellyfish



a)	Multiobjective optimization inspired by behavior of jellyfish for solving structural design problems	Title
	Chaos, Solitons and Fractals 135 (2020) 109738, https://doi.org/10.1016/j.chaos.2020.109738	Journal
	Jui-Sheng Chou, Dinh-Nhat Truong	Author(s)

Fish Sail

opt

inspired from

- ☛ Hunting
- ☛ Sailfish as a predator
- ☛ Group of sardines as preys

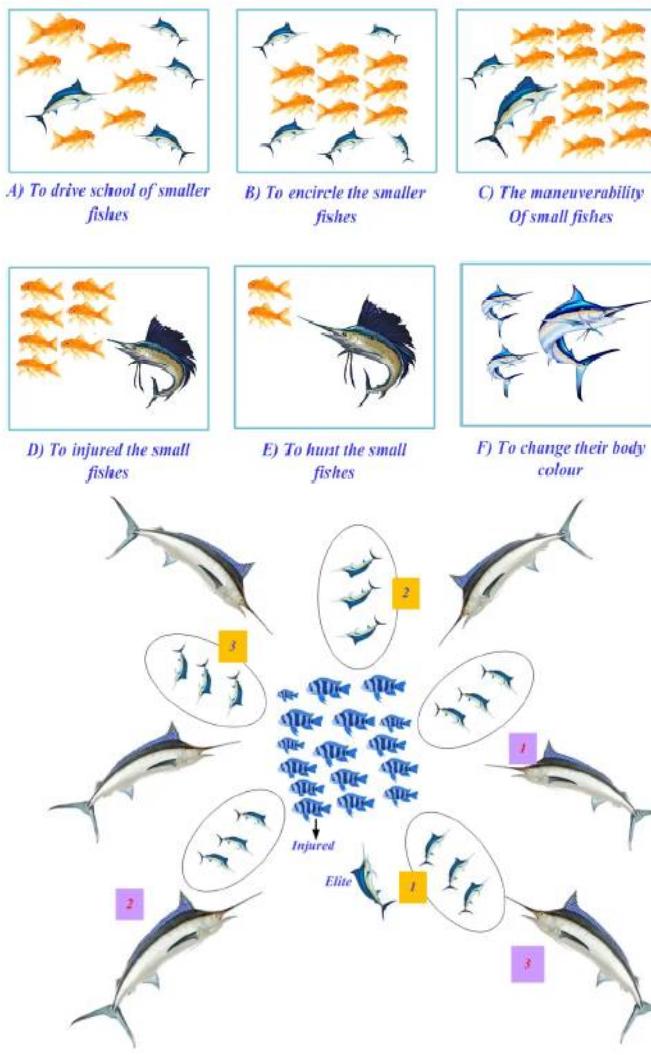
<i>Animalia</i>	<i>Actinopterygii</i>	<i>Istiophoriformes</i>
Kingdom	Class	Order

- Large bony fishes,
- crustaceans
- Squid

Prey

- Shark species,
- Orcas
- Dolphinfish (also known as mahi mahi)

Predators



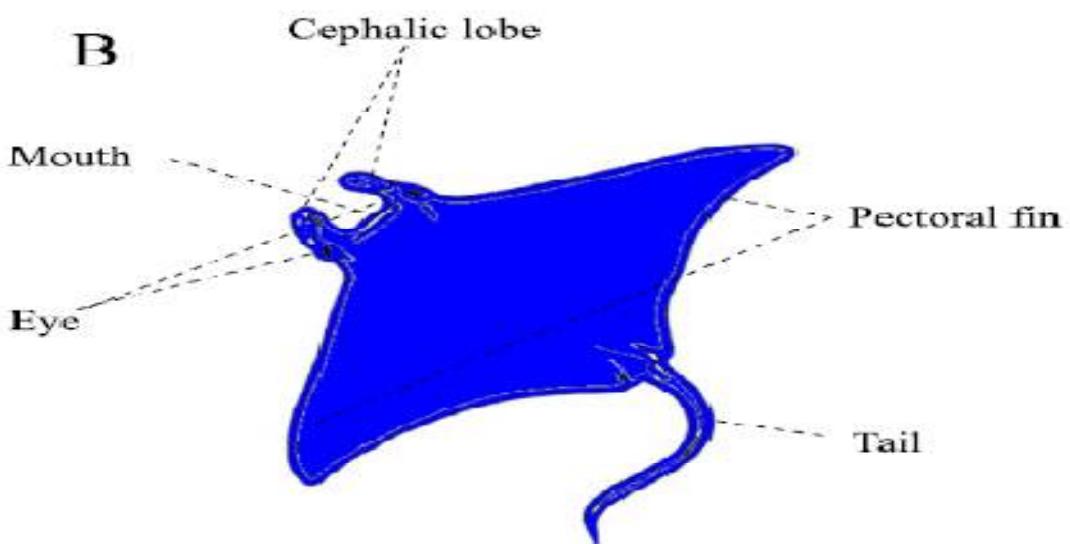
Sailfish's Algorithm

a)	Improved Binary Sailfish Optimizer Based on Adaptive -Hill Climbing for Feature Selection IEEE ACCESS (2020), DOI: 10.1109/ACCESS.2020.2991543	Title Journal
	Kushal Kanti Ghosh, Shameem Ahmed, Pawan Kumar Singh, Zong Woo Geem And Ram Sarkar	Author(s)
b)	A modified sailfish optimizer to solve dynamic berth allocation problem in conventional container terminal International Journal of Industrial Engineering Computations 10 (2019) 491–504, doi: 10.5267/j.ijiec.2019.4.002	Title Journal
	Issam El Hammoutia, AzzaLajjam, Mohamed El Merouani and Yassine Tabaa	Author(s)

Manta Ray Foraging

opt

inspired from Intelligent behaviors (chain / cyclone/somersault foraging) of manta rays



A foraging manta ray, and (B) structure of a manta ray

a)	Manta ray foraging optimization: An effective bio-inspired optimizer for engineering applications Engineering Applications of Artificial Intelligence 87 (2020) 103300, https://doi.org/10.1016/j.engappai.2019.103300 Weiguo Zhao, Zhenxing Zhang, Liying Wang	Title Journal Author(s)
----	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------

Heron Green	opt
inspired from	Inspired by the fishing skills of the bird



Preying Habit with Bait of Green Heron Bird

a)	Green Heron Swarm Optimization Algorithm - State-of-the-Art of a New Nature Inspired Discrete Meta-Heuristics arXiv: 1310.3805v [Cs.NE] [4 th Oct 2013]	Title Journal
	Chiranjib Sur, Anupam Shukla	Author(s)

Mouth Brooding Fish

opt

inspired from

☞ Mouth Brooding Fishin nature

- ➲ In nature, different species of mouth brooding fish secure their offspring intheir mouths as a barrier against danger.
- ➲ Once hatched, the cichlids, instinctively decide to swim back and shelter when theyfeel at stake.
- ➲ As they become mature, the mother's mouth does not have enough space for all the young. →As a result, theweaker cichlids lag behind, when at risk, and have to confront natural forces (such as strong waves) and dangers (such asshark attacks)

a)	Developing the seismic fragility analysis with fuzzy random variables using Mouth Brooding Fish algorithm Applied Soft Computing Journal (2020), https://doi.org/10.1016/j.asoc.2020.106190 .	Title Journal
	Elaheh Ebrahimi, GholamrezaAbdollahzadeh, Ehsan Jahani	Author(s)

Shark

opt

inspired from

Foraging and sexual behaviour in nature

a)	The shark-search algorithm. An application: tailored Web site mapping Computer Networks and ISDN Systems 30 (1998) 317-326	Title Journal
	Michael Hersovici, Michal Jacovi, Yoelle S. Maarek, Dan Pelleg, Menachem Shtalhaim, Sigalit Ur	Author(s)
b)	Shark Smell Optimizer applied to identify the optimal parameters of the proton exchange membrane fuel cell model Energy Conversion and Management 182 (2019) 1–8, https://doi.org/10.1016/j.enconman.2018.12.057	Title Journal
	Yongsheng Rao, Zehui Shao, Arash Hosseini Ahangarnejad, Ehsan Gholamalizadeh, Behnam Sobhani	Author(s)

c)	Photovoltaic cells parameters extraction using variables reduction and improved shark optimization technique International journal of hydrogen energy (2020), https://doi.org/10.1016/j.ijhydene.2020.01.236	Title Journal
	Shanshan Chen, SaeidGholamiFarkoush, Sebastian Leto	Author(s)
d)	A New Metaheuristic Algorithm Based on Shark Smell Optimization Wiley Periodicals, Inc., Vol. 21 No. 5 (2014), DOI 10.1002/cplx.21634	Title Journal
	OVEIS ABEDINIA, NIMA AMJADY AND ALI GHASEMI	Author(s)

e)	Short-Term Wind Power Prediction Based on Hybrid Neural Network and Chaotic Shark Smell Optimization INTERNATIONAL JOURNAL OF PRECISION ENGINEERING AND MANUFACTURING-GREEN TECHNOLOGY (2015), Vol. 2, No. 3, 245-254, DOI: 10.1007/s40684-015-0029-4	Title Journal
	OveisAbedinia and NimaAmjady	Author(s)
f)	A multiyear DG-incorporated framework for expansion planning of distribution networks using binary chaotic shark smell optimization algorithm Energy 102 (2016) 199-215, http://dx.doi.org/10.1016/j.energy.2016.02.088	Title Journal
	Masoud Ahmadigorji, NimaAmjady	Author(s)

g)	Optimal placement of capacitors in radial distribution system using shark smell optimization algorithm Ain Shams Engineering Journal (2016), http://dx.doi.org/10.1016/j.asej.2016.01.006	Title Journal
	N. Gnanasekaran, S. Chandramohan, P. Sathish Kumar, A. Mohamed Imran	Author(s)
h)	Parameter identification of solid oxide fuel cell by Chaotic Binary Shark Smell Optimization method Energy (2019), doi: https://doi.org/10.1016/j.energy.2019.07.100 .	Title Journal
	Ya Wei, Russell J. Stanford	Author(s)
i)	Medical image fusion using a modified shark smell optimization algorithm and hybrid wavelet-homomorphic filter Biomedical Signal Processing and Control 59 (2020) 101885, https://doi.org/10.1016/j.bspc.2020.101885	Title Journal
	Lina Xu, Yujuan Si, Saibiao Jiang, Ying Sun, Homayoun Ebrahimian	Author(s)

j)	New Improved Optimized Method for Medical Image Enhancement Based on Modified Shark Smell Optimization Algorithm Sensing and Imaging (2020) 21:20, https://doi.org/10.1007/s11220-020-00283-6	Title Journal
	Yuebin Zhou, Jianmin Ye, Yujin Du, Fatima Rashid Sheykhammad	Author(s)
k)	A novel evolutionary technique based on electrolocation principle of elephant nose fish and shark : fish electrolocation optimization Soft Comput (2016), DOI 10.1007/s00500-016-2033-1	Title Journal
	Vivekananda Haldar, Niladri Chakraborty	Author(s)

Killer-Whale		opt
inspired from  Smell (of blood drops) recognition from a few miles in open ocean		

a)	Optimization of Energy Efficiency and Conservationin Green Building Design Using Duelist, Killer-Whale and Rain-Water Algorithms IOP Conf. Series: Materials Science and Engineering 267 (2017) 012036 doi:10.1088/1757-899X/267/1/012036	Title Journal
	T R Biyanto, Matradji, M N Syamsi, H Y Fibrianto, N Afdanny, A H Rahman, K S Gunawan, J A D Pratama, A Malwindasari, A I Abdillah, T N Bethiana and Y A Putra	Author(s)
b)	IWOA: An improved whale optimization algorithm for optimization problems Journal of Computational Design and Engineering 6 (2019) 243–259, https://doi.org/10.1016/j.jcde.2019.02.002	Title Journal
	Seyed Mostafa Bozorgi, Samaneh Yazdani	Author(s)

c)	Sperm Whale Algorithm: an Effective Metaheuristic Algorithm for ProductionOptimization Problems Journal of Natural Gas Science &Engineering (2016), doi: 10.1016/j.jngse.2016.01.001.	Title Journal
	A. Ebrahimi, E. Khamehchi	Author(s)
d)	Chaotic multi-swarm whale optimizer boosted support vector machine formedical diagnosis Applied Soft Computing Journal (2019), https://doi.org/10.1016/j.asoc.2019.105946 .	Title Journal
	Mingjing Wang, Huiling Chen	Author(s)

e)	The Whale Optimization Algorithm Advances in Engineering Software 95 (2016) 51–67, http://dx.doi.org/10.1016/j.advengsoft.2016.01.008	Title Journal
	SeyedaliMirjalili, Andrew Lewis	Author(s)
f)	Augmented whale feature selection for IoT attacks: Structure, analysis and applications	Title

	Future Generation Computer Systems 112 (2020) 18–40, https://doi.org/10.1016/j.future.2020.05.020	Journal
	MajdiMafarja, Ali Asghar Heidari, Maria Habib, Hossam Faris, ThaerThaher,Ibrahim Aljarah	Author(s)

g)	Whale Optimization Algorithm and Moth-Flame Optimization for multilevel thresholding image segmentation Expert Systems With Applications 83 (2017) 242–256, http://dx.doi.org/10.1016/j.eswa.2017.04.023	Title Journal
	Mohamed Abd El Aziz, Ahmed A. Ewees, Aboul Ella Hassani	Author(s)
h)	Optimization of Energy Efficiency and Conservationin Green Building Design Using Duelist, Killer-Whaleand Rain-Water Algorithms IOP Conf. Series: Materials Science and Engineering 267 (2017) 012036, doi:10.1088/1757-899X/267/1/012036	Title Journal
	T R Biyanto, Matradji, M N Syamsi, H Y Fibrianto, N Afdanny, A H Rahman, K S Gunawan, J A D Pratama, A Malwindasari, A I Abdillah, T N Bethiana and Y A Putra	Author(s)
i)	Killer Whale Algorithm: An Algorithm Inspired by the Life of Killer Whale Procedia Computer Science 124 (2017) 151–157, DOI:10.1016/j.procs.2017.12.141	Title Journal
	Totok R. Biyanto, Matradjia, Sonny Irawan, Henokh Y. Febrianto, NaindarAfdanny,Ahmad H. Rahman, Kevin S. Gunawan, Januar A. D. Pratama, Titania N. Bethiana	Author(s)

j)	Application of Killer Whale Algorithm in ASP EOR Optimization Procedia Computer Science 124 (2017) 158–166, DOI: 10.1016/j.procs.2017.12.142	Title Journal
	Totok R. Biyanto, Matradji, Sawal, Ahmad H. Rahman, Arfiq I. Abdillah,Titania N. Bethiana, Sonny Irawan	Author(s)
k)	Modified Artificial Killer Whale OptimizationAlgorithm for Maximum Power Point Tracking underPartial Shading Condition 2017 International Conference on Recent Trends in Electrical, Electronics and Computing Technologies, DOI 10.1109/ICRTEECT.2017.34	Title Journal
	Shweta Gupta, Kumar Saurabh	Author(s)

l)	Whale Optimization Algorithm Based onLamarckian Learning for GlobalOptimization Problems IEEE ACCESS, VOLUME 7, (2019), DOI: 10.1109/ACCESS.2019.2905009	Title Journal
	QIANG ZHANG, AND LIJIE LIU	Author(s)
m)	A Brief Review of Applications of Whale Optimization Algorithm to Mechanical and Production Engineering International Journal of Pure and Applied Mathematics (2018), Volume 119, No. 18, 1953-1960.	Title Journal
	Mohit Verma, Amit Kumar	Author(s)

Aves (Kingdom:Animalia) (biology)

..... Birds.....

Humming Birds

opt

inspired from

☞ Foraging process of hummingbirds



A real hummingbird who is gathering nectar

a)	An optimization method: hummingbirds optimization algorithm Journal of Systems Engineering and Electronics Vol. 29, No. 2, (2018), 386 – 404 ZHANG Zhuoran, HUANG Changqiang, HUANG Hanqiao, TANG Shangqin, and DONG Kangsheng	Title Journal Author(s)
----	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------

Caledonian Crow Learning

opt

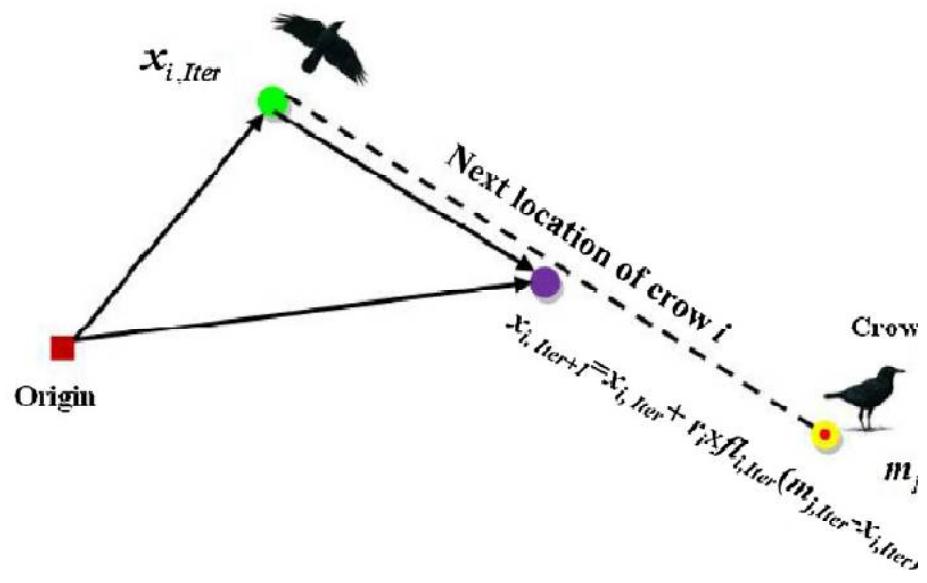
inspired from

- ☞ Efficient social, asocial, and reinforcement mechanism that New Caledonian (NC)-crows use to learn behaviors for developing tools from Pandanus trees to obtain food
- ☞ Crows are ravening birds, as they keep track of each other to find better food sources.
- ☞ Their capacity to remember where food is stored across seasons is superior to that of other birds. The process of obtaining food resources unobserved by other crows is a difficult task.
- ☞ Crows carry out the following intelligent ruse: a crow attempts to cheat another crow by flying to another location if it feels that another one is following it. The main idea from the optimization point of view is based on the crow's natural behavior as a searcher



New Caledonian crows holding-wide-pandanus-tools

- $\beta < 1$



a)	New Caledonian crow learning algorithm: A new metaheuristic algorithm for solving continuous optimization problems Applied Soft Computing Journal (2020), https://doi.org/10.1016/j.asoc.2020.106325 W. Al-Sorori and A.M. Mohsen	Title Journal Author(s)
b)	Chaotic crow search algorithm for fractional optimization problems Applied Soft Computing, 71 (2018) 1161–1175, https://doi.org/10.1016/j.asoc.2018.03.019 Rizk M. Rizk-Allah, Aboul Ella Hassani, Siddhartha Bhattacharyya	Title Journal Author(s)
c)	Development and applications of an intelligent crow search algorithm based on opposition based learning ISA Transactions, 99 (2020) 210–230, https://doi.org/10.1016/j.isatra.2019.09.004 Shalini Shekhawat, Akash Saxena	Title Journal Author(s)

Harris Hawk

opt

inspired from

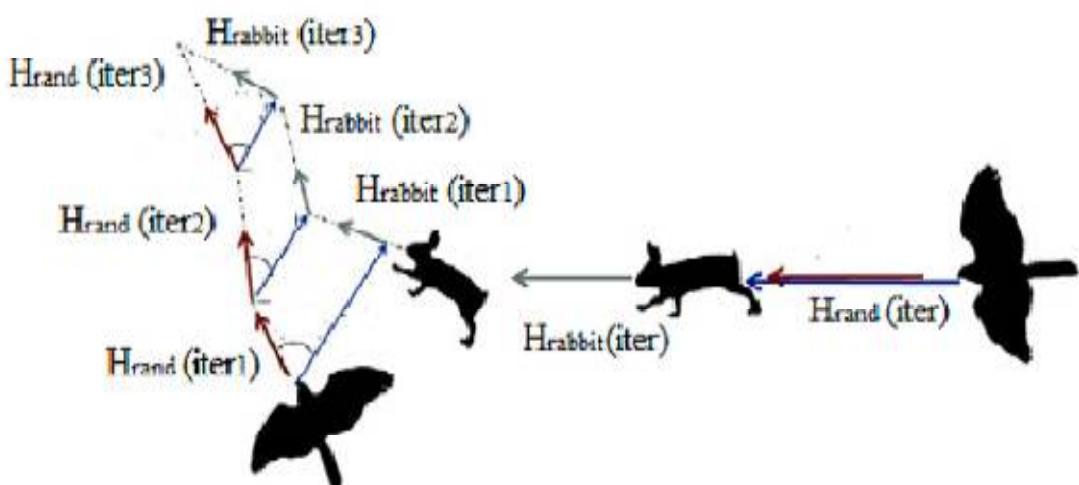
- ☞ Natural hunting behavior
- ☞ Escaping or avoiding nature of the prey

Hybrid

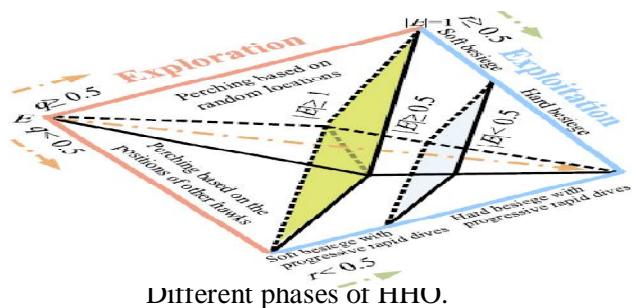
Harris Hawks + Sine Cosine



Harris's hawk.



Surprise Attack.



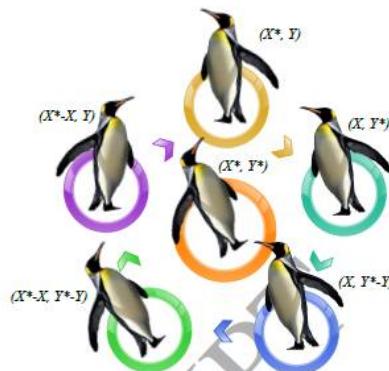
a)	A novel hybrid Harris hawks optimization and support vector machines for drug design and discovery Computers and Chemical Engineering, 133 (2020) 106656, https://doi.org/10.1016/j.compchemeng.2019.106656 Essam H. Houssein, Mosa E. Hosney, Diego Oliva, Waleed M. Mohamed, M. Hassaballah	Title Journal Author(s)
b)	A Novel Hybrid Harris Hawks Optimization and Support Vector Machines for Drug Design and Discovery Drug Design and Discovery, Computers and Chemical Engineering (2019), doi.org/10.1016/j.compchemeng.2019.106656 Essam H. Houssein, Mosa E. Hosney, Diego Oliva, Waleed M. Mohamed, M. Hassaballah	Title Journal Author(s)
c)	Harris hawks optimization: Algorithm and applications Future Generation Computer Systems 97 (2019) 849–872, Ali Asghar Heidari, SeyedaliMirjalili, Hossam Faris, Ibrahim Aljarah, MajdiMafarja, Huiling Chen	Title Journal Author(s)
d)	A differential evolutionary adaptive Harris hawks optimization for two dimensional practical Masi entropy-based multilevel image thresholding Journal of King Saud University – Computer and Information Sciences (2020), https://doi.org/10.1016/j.jksuci.2020.05.001 Aneesh Wunnava, Manoj Kumar Naik, Rutuparna Panda, Bibekananda Jena, Ajith Abraham	Title Journal Author(s)
e)	An intensify Harris Hawks optimizer for numerical and engineering optimization problems Applied Soft Computing Journal 89 (2020) 106018, https://doi.org/10.1016/j.asoc.2019.106018 Vikram Kumar Kamboj, Ayani Nandi, Ashutosh Bhadoria, Shivani Sehgal	Title Journal Author(s)

Emperor Penguin opt

inspired from	During huddling, emperor penguins generally position themselves on a polygon shape grid boundary. The emperor penguins have at least two neighbors which are chosen randomly in the huddle
---------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------



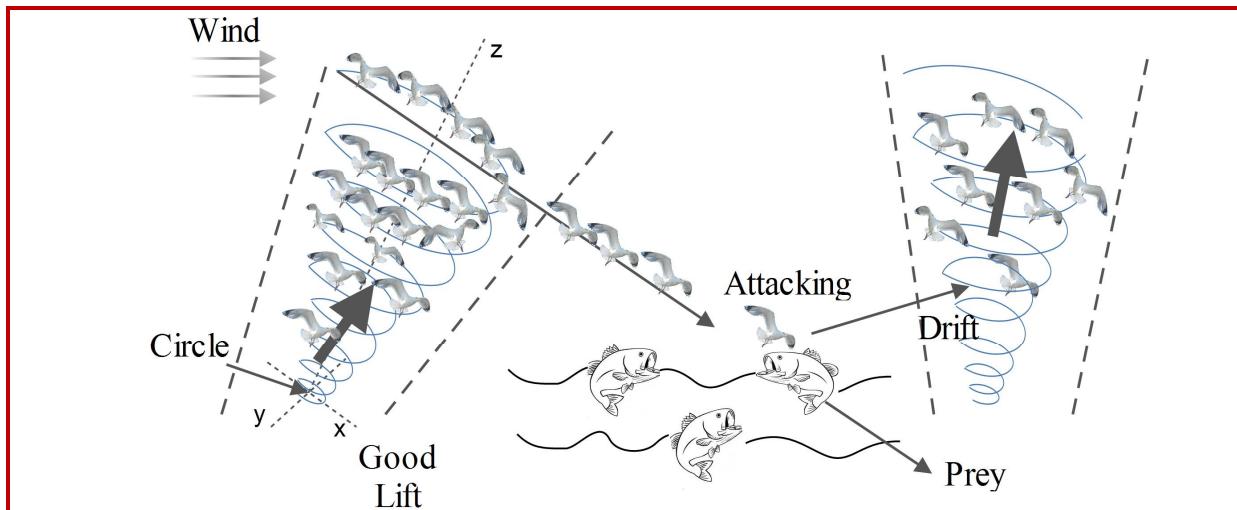
Huddling behavior of emperor penguins



a)	A memetic algorithm using emperor penguin and social engineering optimization for medical data classification	Title
	Applied Soft Computing Journal 85 (2019) 105773, https://doi.org/10.1016/j.asoc.2019.105773	Journal
	Santos Kumar Baliarsingh, Weiping Ding, Swati Vipsita, SambitBakshi	Author(s)

b)	Emperor Penguin Optimizer: A Bio-inspired Algorithm for Engineering Problems	Title
	Knowledge-Based Systems (2018), doi:10.1016/j.knosys.2018.06.001	Journal
	Gaurav Dhiman, Vijay Kumar	Author(s)

Seagull	opt
inspired from <ul style="list-style-type: none"> ☛ Migration and attacking behaviors of seagulls (seabirds) -- very intelligent birds ☛ Seagulls use bread crumbs to attract fish ☛ Produce rain-like sound with their feet to attract earthworms hidden under the ground ☛ Seagulls can drink both fresh and salt water 	



a)	Seagull optimization algorithm: Theory and its applications for large-scale industrial engineering problems.	Title
	Knowl.-Based Syst. (2019), 165, 169–196, https://doi.org/10.1016/j.knosys.2018.11.024	Journal
	Dhiman, G., Kumar, V.,	Author(s)
b)	Experimental modeling of PEM fuel cells using a new improved seagull optimization algorithm	Title
	Energy Reports 5 (2019) 1616–1625, https://doi.org/10.1016/j.egyr.2019.11.013	Journal
	Yan Cao, Yiqing Li, Geng Zhang, KittisakJermstittiparsert, NavidRazmjoo	Author(s)
c)	A New Hybrid Seagull Optimization Algorithm for Feature Selection	Title
	IEEE Access, VOLUME 7, (2019), DOI: 10.1109/ACCESS.2019.2909945	Journal
	Heming Jia, Zhikai Xing And Wenlong Song	Author(s)

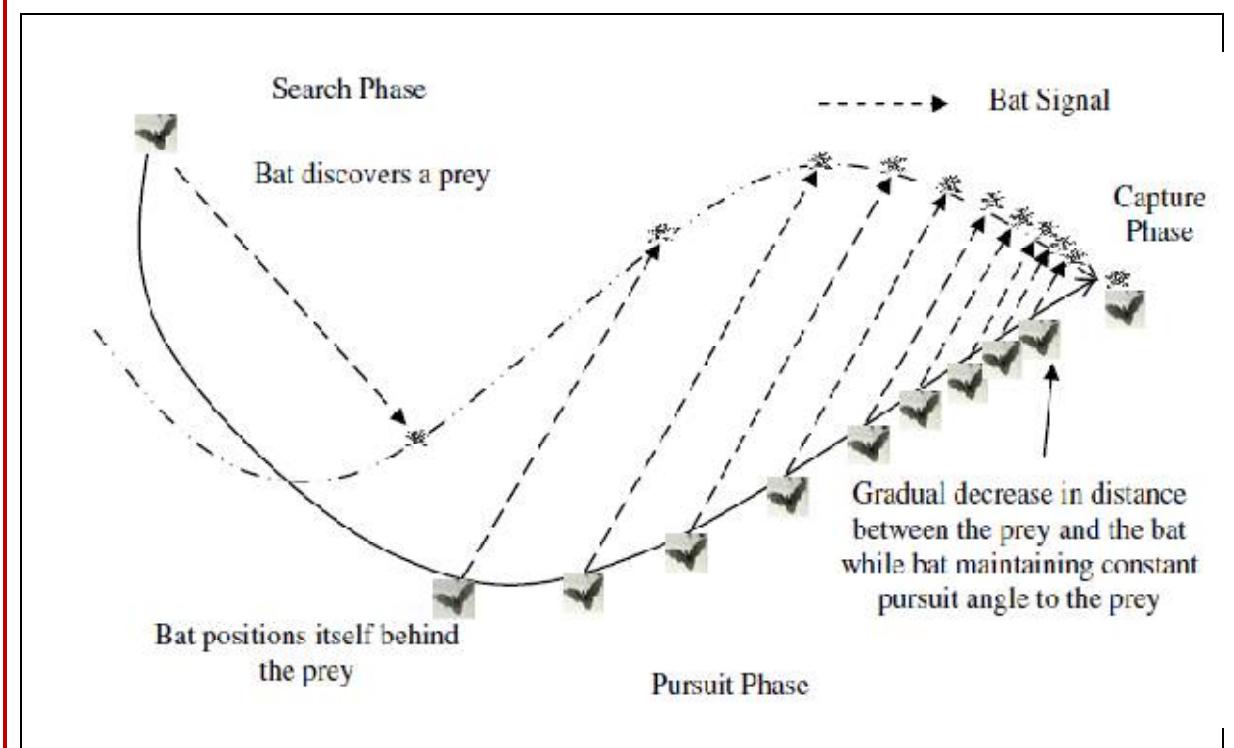
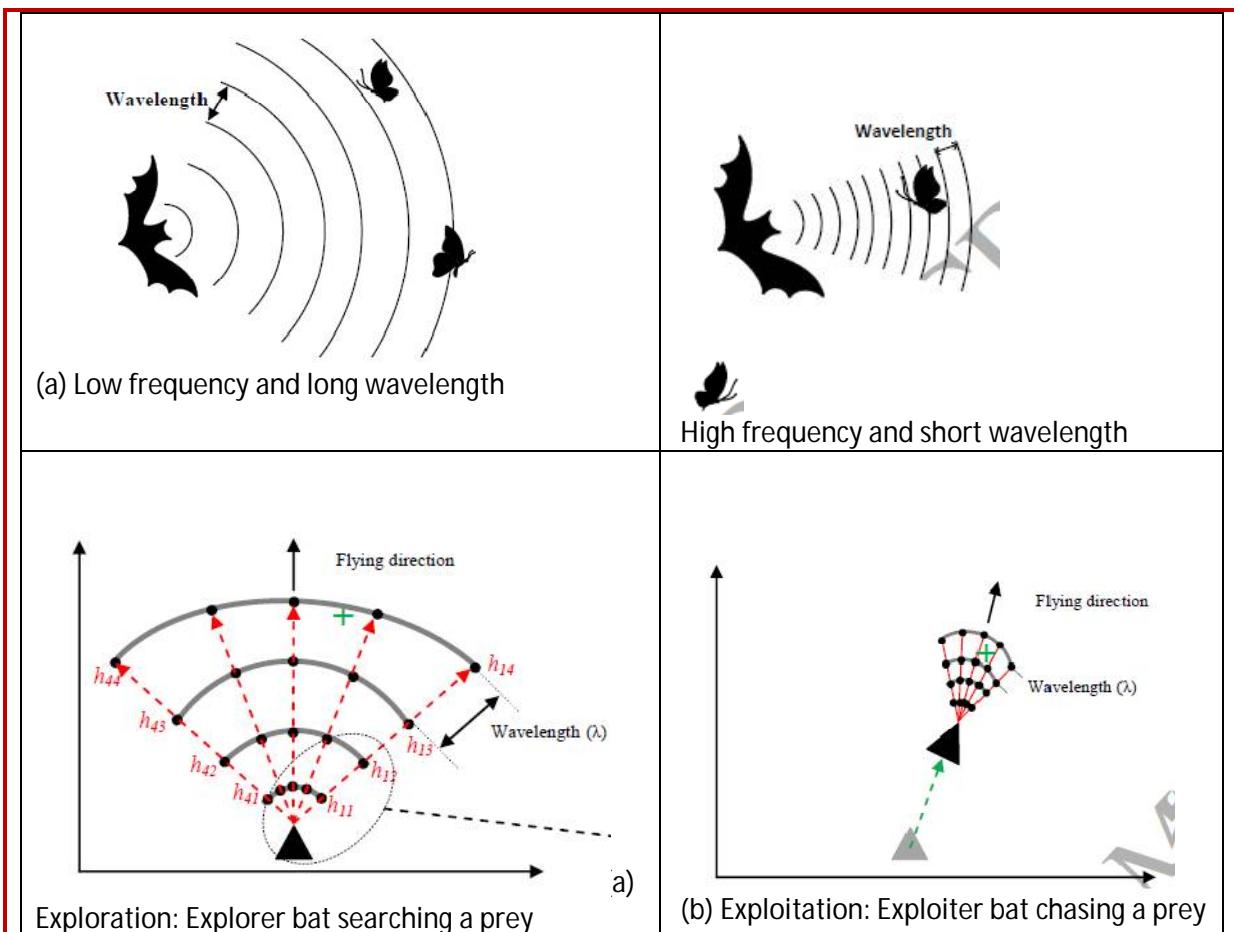
..... Mammals those can truly fly

Bats

opt

inspired from

- ☞ Echolocation in locating prey and/or an obstacle
- ☞ To perceive their immediate surrounding environment



a)	Bat algorithm and cuckoo search algorithm – Book Chapter Nature-Inspired Computation and Swarm Intelligence. https://doi.org/10.1016/B978-0-12-819714-1.00011-7	Title Journal
	Xin-She Yang, Xing-Shi He	Author(s)
b)	Bat intelligence search with application to multi-objective multiprocessorscheduling optimization Int J Adv ManufTechnol (2012) 60:1071–1086, DOI 10.1007/s00170-011-3649-z	Title Journal
	Behnam Malakooti& Hyun Kim & Shaya Sheikh	Author(s)

c)	A novel meta-heuristic algorithm: Dynamic Virtual Bats Algorithm Information Sciences 00 (2016) 1–18, DOI: 10.1016/j.ins.2016.03.025	Title Journal
	Ali Osman Topal, OguzAltun	Author(s)
d)	Bat-inspired algorithm for feature selection and white blood cell classification Nature-Inspired Computation and Swarm Intelligence, https://doi.org/10.1016/B978-0-12-819714-1.00022-1	Title Journal
	Deepak Gupta, Utkarsh Agrawal, Jatin Arora, Ashish Khanna	Author(s)
e)	A TRIZ-inspired bat algorithm for gene selection in cancer classification Genomics (2019), https://doi.org/10.1016/j.ygeno.2019.09.015	Title Journal
	Mohammed Azmi Al-Betar, Osama Ahmad Alomari, Saeid M. Abu-Romman	Author(s)

Plant kingdom

Plant Intelligence

opt

inspired from

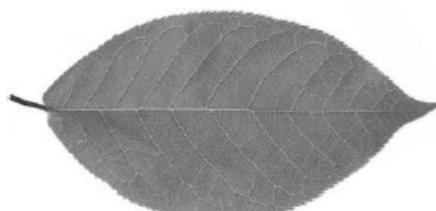
- ☞ Intelligent behaviour (ability to use previously stored memory to respond to new problem) of plants

Plant leaf

opt

inspired from

- ☞ Crack resistance
- ☞ Excellent surface properties and functions
- ☞ Efficiently withstand long-term alternating loads caused by wind and rain loads



Plant saplings sowing and growing

opt

inspired from

☞ Evolution of growing up of trees

a)	Plant intelligence Naturwissenschaften (2005) 92: 401–413 DOI 10.1007/s00114-005-0014-9 Anthony Trewavas	Title Journal Author(s)
b)	A method for improving the crack resistance of aluminum alloy aircraft skin inspired by plant leaf Theoretical and Applied Fracture Mechanics (2019), https://doi.org/10.1016/j.tafmec.2019.102444 Lushen Wu, Teng Wang, Yun Hu, Jiaming Liu, Minjie Song	Title Journal Author(s)
c)	A New Plant Intelligent Behaviour Optimisation Algorithm for Solving Vehicle Routing Problem Mathematical Problems in Engineering (2018), Article ID 9874356, https://doi.org/10.1155/2018/9874356 Godfrey Chagwiza	Title Journal Author(s)
d)	Theory of Saplings Growing up Algorithm DOI: 10.1007/978-3-540-71618-1_50 · Source: DBLP Ali Karci	Title Journal Author(s)

Pollination Flower`

opt

inspired from

☞ Survival of the fittest and optimal reproduction of plants

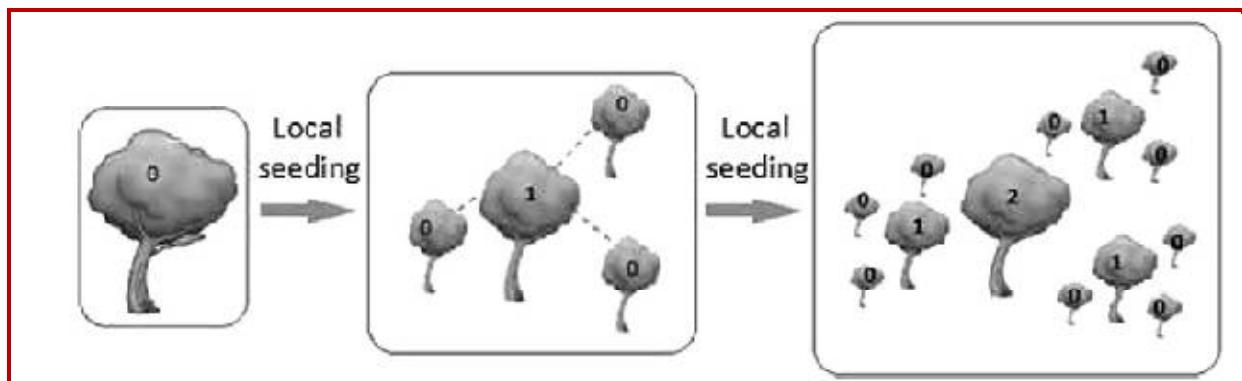
a)	Hybridization of Chaos and Flower Pollination Algorithm over K-Means for data clustering Applied Soft Computing Journal (2019), https://doi.org/10.1016/j.asoc.2019.105523 Arvinder Kaur, Saibal Kumar Pal, Amrit Pal Singh	Title Journal Author(s)
b)	Artificial Flora (AF) Optimization Algorithm Appl. Sci. (2018), 8, 329; doi:10.3390/app8030329 Long Cheng, Xue-han Wu and Yan Wang	Title Journal Author(s)

Forest

opt

inspired from

- ☞ Some trees outlive others based better survival conditions
- ☞ Seeding process of trees in a forest
- ☞ Local and global seed dispersion processes



Happenings in nature

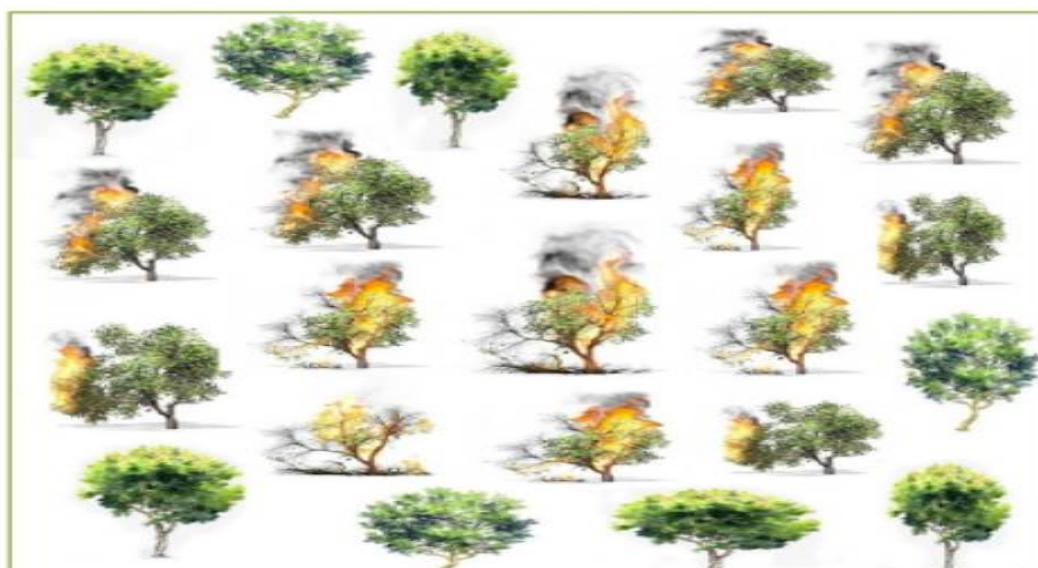
- Forest fire
- Lightning
- Big-bang
- Black hole
- River formation

Forest fire

opt

inspired from

Spread of wildfire in a forest



a)	A nature - inspired approach based on Forest Fire model for modeling rumor propagation in social networks Journal of Network and Computer Applications 125 (2019) 28–41, https://doi.org/10.1016/j.jnca.2018.10.003	Title Journal
	V. Indu, SabuM. Thampi	Author(s)
b)	Ensemble Based Classification of Sentiments Using Forest Optimization Algorithm Data (2019), 4, 76; doi:10.3390/data4020076	Title Journal
	Mehreen Naz, Kashif Zafar and Ayesha Khan	Author(s)

c)	Feature Selection with a Local Search Strategy Based on the Forest Optimization Algorithm CMES (2019), vol.121, no.2, pp.569-592, doi:10.32604/cmes.2019.07758	Title Journal
	Tinghuai Ma, Honghao Zhou, Dongdong Jia, Abdullah Al-Dhelaan, Mohammed Al-Dhelaan and Yuan Tian	Author(s)

d)	<p>Feature Selection Using Improved Forest Optimization Algorithm</p> <p>Information Technology and Control , (2020), Vol. 49, No. 2, 289-301, DOI 10.5755/j01.itc.49.2.24858</p> <p>Qi Xie, Gengguo Cheng, Xiao Zhang, Peng Lei</p>	Title Journal Author(s)
e)	<p>Forest Optimization Algorithm</p> <p>Expert Systems with Applications 41 (2014) 6676–6687, http://dx.doi.org/10.1016/j.eswa.2014.05.009</p> <p>ManizhehGhaemi, Mohammad-Reza Feizi-Derakhshi</p>	Title Journal Author(s)
f)	<p>A benchmark dataset for ensemble framework by using nature inspired algorithms for the early-stage forest fire rescue</p> <p>Data in Brief 31 (2020) 105686, https://doi.org/10.1016/j.dib.2020.105686</p> <p>HongGuang Zhang, ZiHan Liang, HuaJian Liu, Rui Wang, YuanAn Liu</p>	Title Journal Author(s)

Salp Swarm

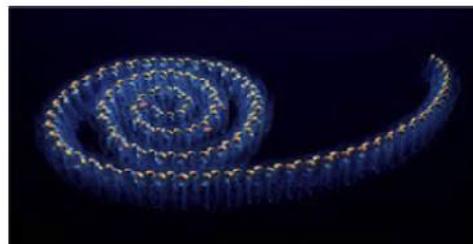
opt

inspired from

☞ Slap is a barrel-shaped, planktonic tunicate



Single salp



Swarm of salp(salp chain).

a)	A Salp-Swarm Optimization based MPPT technique for harvesting maximum energy from PV systems under partial shading conditions Energy Conversion and Management, 209 (2020) 112625, https://doi.org/10.1016/j.enconman.2020.112625	Title
		Journal
	Adeel Feroz Mirza, Majad Mansoor, Qiang Ling, Baoqun Yin, M. Yaqoob Javed	Author(s)
b)	Improved-salp swarm optimized type-II fuzzy controller in load frequency control of multi area islanded AC microgrid	Title

	Sustainable Energy, Grids and Networks 16 (2018) 380–392, https://doi.org/10.1016/j.segan.2018.10.003	Journal
	Prakash Chandra Sahu, Sonalika Mishra, Ramesh Chandra Prusty, Sidhartha Panda	Author(s)

c)	A new combined model based on multi-objective salp swarm optimization for wind speed forecasting Applied Soft Computing Journal 92 (2020) 106294, https://doi.org/10.1016/j.asoc.2020.106294	Title Journal
	Zishu Cheng, Jiyang Wang	Author(s)
d)	Improved salp swarm algorithm for feature selection Journal of King Saud University – Computer and Information Sciences (2018), https://doi.org/10.1016/j.jksuci.2018.06.003	Title Journal
	Ah. E. Hegazy, M. A. Makhlof, Gh. S. El-Tawe	Author(s)

Bladder Worts Suction Plant intelligence

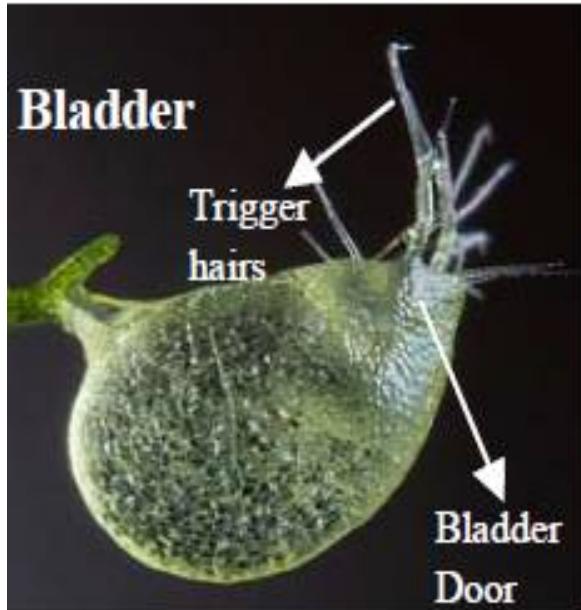
opt

inspired from

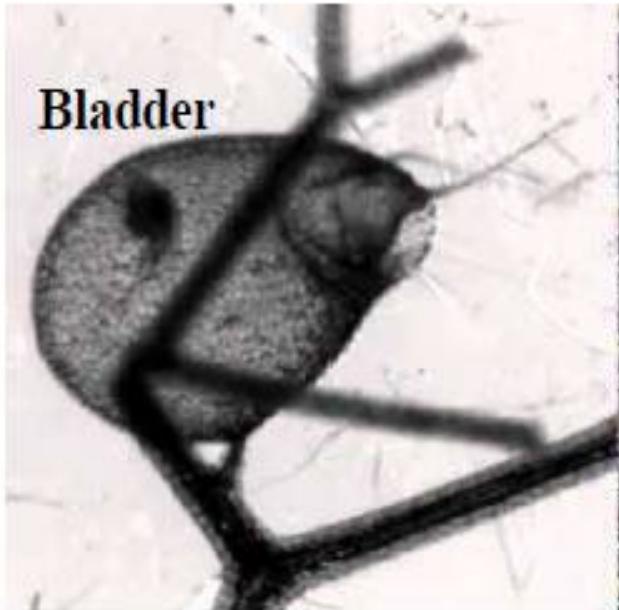
- ☞ Foraging mechanism of Venus Flytrap Plant
- ☞ Foraging suction mechanism (prey capturing) of Utricularia plants
- ☞ BladderWorts Suction is a novel Plant intelligence process



An Utricularia Bladderworts Plant with numerous Bladders in its shoot



(c)



(d)

(c) A single Utricularia bladder with trigger hairs in its door(mouth) part
 (d) Inflated Utricularia bladder with a captured prey

a)	Non-Swarm Plant Intelligence Algorithm: Bladderworts Suction (BWS) Algorithm 2018 International Conference on Circuits and Systems in Digital Enterprise Technology (ICCSDET), DOI: 10.1109/ICCSDET.2018.8821225	Title Journal
R. Gowri, R. Rathipriya		Author(s)

Nature Inspired Algorithms (NIA)

Information Source	ACS.org ; sciencedirect.com
R. Sambasiva Rao, School of Chemistry, Andhra University, Visakhapatnam 530 003, India	K. Somasekhara Rao, Dept. of Chemistry, Acharya Nagarjuna Univ., Dr. M.R.Appa Rao Campus, Nuzvid-521 201, India