

Research Report

An application-based taxonomy of Nature Inspired Intelligent algorithms

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Last update: November 12, 2019

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About this report

The rapidly growing field of Nature Inspired Intelligent techniques consists of more than 200 algorithms. Thus, it is hard to keep an eye on all these schemes and study them. In this report all nature-inspired algorithms (NIAs) are classified according to the problems on which they were applied in the work that they were initially introduced. This taxonomy presents three classes: (a) algorithms without application, (b) algorithms tested only in benchmark functions and (c) algorithms coping with real world problems when they were initially introduced.

The interested researcher can find useful information about the initial application area of each Nature Inspired Intelligent (NII) algorithm, while he can also discover the paper into which every algorithm has been introduced in literature for the first time.

Has the algorithm been applied in real problems in the initial work?

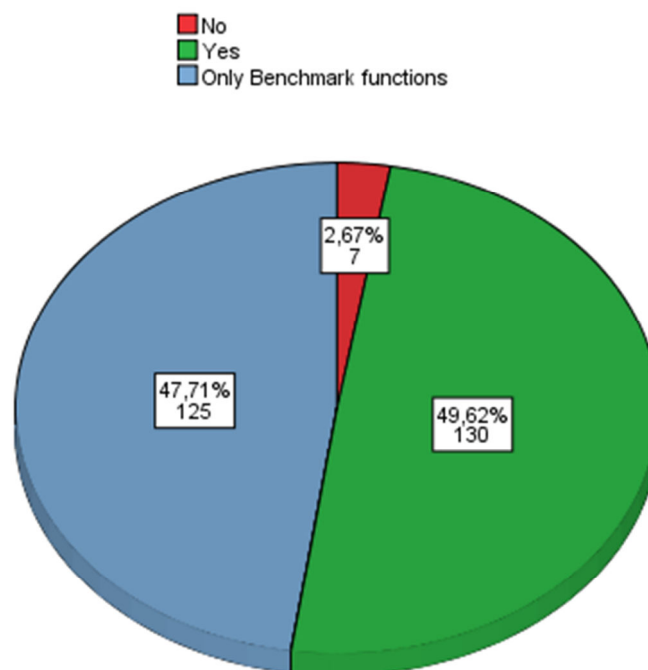


Figure 1: How many nature-inspired algorithms tackle real world problems in their initial work?

At the end of the report, the paper where each algorithm was initially proposed is cited.

How to cite this report:

Tzanetos, A. and Dounias, G., 2019. *An application-based taxonomy of Nature Inspired Intelligent algorithms*. [Research Report] Chios, Greece: Management and Decision Engineering Laboratory (MDE-Lab) University of the Aegean, School of Engineering, Dept. of Financial and Management Engineering. Available at: <<http://mde-lab.aegean.gr/images/stories/docs/reportnii2019.pdf>> [Accessed dd Mm. yyyy].

Nature Inspired Algorithms without application in their proposed form

The algorithms included in Table 1 below were not applied in any problem in their first appearance. As someone can see, all these algorithms have been presented before 2010, when the need to present the performance in some benchmark problems has been made necessary.

Table 1: NIAs which were not applied in any problem in their first appearance

Algorithm	Reference
Ant Colony Optimization	(Dorigo, 1992)
Bacterial Foraging Optimization	(Passino, 2002)
BeeHive	(Wedde, Farooq and Zhang, 2004)
Glowworm Swarm-based Optimization	(Krishnanand and Ghose, 2006)
Hysteretic Optimization	(Zarand et al., 2002)
Japanese Tree frogs calling	(Aihara et al., 2008)
Saplings Growing Up algorithm	(Karci and Alatas, 2006)

However, some of them are considered established techniques with numerous applications, such as Ant Colony Optimization (11,515 citations based on Google Scholar).

Nature Inspired Algorithms applied only in benchmark functions in their initial work

After 2010, the comparison between methods has been done a difficult task because of the increasing number of nature-inspired intelligent methods. In some cases, authors tested their proposed schemes in benchmark mathematical functions to show the performance of the proposed algorithm in opposition with another older method. In Table 2 below, all these algorithms are mentioned.

Table 2: NIAs that were tested on benchmark functions in their initial work

Algorithm	Reference
Allostatic Optimization	(Osuna-Enciso et al., 2016)
Animal Migration Optimization	(Li, Zhang and Yin, 2014)
Artificial Bee Colony	(Karaboga and Basturk, 2007)
Artificial Butterfly Optimization	(Qi, Zhu and Zhang, 2017)
Artificial Electric Field Algorithm	(Yadav, 2019)
Artificial Infectious Disease Optimization	(Huang, 2016)
Artificial Physics Optimization	(Xie, Zeng and Cui, 2009)
Artificial Searching Swarm Algorithm	(Chen, 2009b)
Artificial Showering Algorithm	(Ali et al., 2015)
Atmosphere Clouds Model Optimization	(Yan and Hao, 2013)
Attraction Force Optimization	(Bendato et al., 2016)
Bacterial Swarming Algorithm	(Tang, Wu and Saunders, 2007)
Bald Eagle Search	(Alsattar, Zaidan and Zaidan, 2019)
Bat Algorithm	(Yang, 2010)
Bat Sonar Algorithm	(Tawfeeq, 2012)
Bee Swarm Optimization	(Akbari, Mohammadi and Ziarati, 2010)
Beetle Antennae Search Algorithm	(Jiang and Li, 2017)
Big Bang - Big Crunch	(Erol and Eksin, 2006)

Bird Mating Optimizer	(Askarzadeh, 2014)
Bird Swarm Algorithm	(Meng et al., 2016)
BladderWorts Suction Algorithm	(R. Gowri and R. Rathipriya, 2018)
Blind,naked Mole-rat Algorithm	(Shirzadi and Bagheri, 2012)
Blue Monkey	(Mahmood and Al-Khateeb, 2019)
Butterfly Optimization Algorithm	(Arora and Singh, 2019)
Camel Algorithm	(Ibrahim and Ali, 2016)
Cat Swarm Optimization	(Chu, Tsai and Pan, 2006)
Cheetah Based Optimization Algorithm	(Klein, Mariani and Coelho, 2018)
Circular Structures of Puffer Fish	(M. C. Catalbas and A. Gulten, 2018)
Circular Water Waves	(Colak and Varol, 2015)
Cockroach Swarm Evolution	(Wu and Wu, 2015)
Cockroach Swarm Optimization ¹	(Zhaohui and Haiyan, 2011)
Collective Animal Behavior	(Cuevas, Fausto and González, 2020)
Competition over Resources	(S. Mohseni et al., 2014)
Coyote Optimization Algorithm	(J. Pierezan and L. Dos Santos Coelho, 2018)
Cuckoo Search	(X. Yang and Suash Deb, 2009)
Cuttlefish Algorithm	(Eesa, Brifcani and Orman, 2013)
Dolphin Partner Optimization	(Y. Shiqin, J. Jianjun and Y. Guangxing, 2009)
Dolphin Swarm Algorithm	(Wu, Yao and Yang, 2016)
Dolphin Swarm Optimization Algorithm	(Yong et al., 2016)
Ecology-inspired Optimization Algorithm	(S. He, Q. H. Wu and J. R. Saunders, 2006)
Electromagnetic Field Optimization	(Abedinpourshotorban et al., 2016)
Electromagnetism-like Optimization	(Birbil and Fang, 2003)
Elephant Herding Optimization	(Wang, Deb and Coelho, 2015a)
Elephant Search Algorithm	(S. Deb, S. Fong and Z. Tian, 2015)
Emperor Penguins Colony	(Harifi et al., 2019)
Evolutionary Centers Algorithm	(Mejía-de-Dios and Mezura-Montes, 2019)
Farmland Fertility Algorithm	(Shayanfar and Gharehchopogh, 2018)
Firefly Algorithm	(Yang, 2009)
Fish School Search	(Filho et al., 2009)
Fish-swarm Algorithm	(Li, Shao and Qian, 2002)
Fitness Dependent Optimizer	(J. M. Abdullah and T. Ahmed, 2019)
Gravitational Interactions Optimization	(Flores, López and Barrera, 2011)
Gravitational Search Algorithm	(Rashedi, Nezamabadi-pour and Saryazdi, 2009)
Grenade Explosion Method	(Ahrari and Atai, 2010)
Group Search Optimizer	(S. He, Q. H. Wu and J. R. Saunders, 2009)
Heart algorithm	(Hatamlou, 2014)
Heat Transfer Search	(Patel and Savsani, 2015)
Hierarchical Swarm Model	(Chen et al., 2010)
Hoopoe Heuristic Optimization	(El-Dosuky et al., 2012)
Hunting Search	(Oftadeh, Mahjoob and Shariatpanahi, 2010)
Hurricane-based Optimization	(Rboun and Imrani, 2014)
Hydrological Cycle Algorithm	(Wedyan, Whalley and Narayanan, 2017)
Invasive Tumor Growth Optimization	(Tang et al., 2015)
Invasive Weed Optimization	(Mehrabian and Lucas, 2006)
Ions Motion Algorithm	(Javidy, Hatamlou and Mirjalili, 2015)
Jaguar Algorithm	(Chen et al., 2015)
Kidney-inspired Algorithm	(Jaddi, Alvankarian and Abdullah, 2017)

¹ Cockroach Swarm Optimization has been presented in 2010 by C. ZhaoHui and T. HaiYan. However, that work has been retracted:

Chen ZhaoHui and Tang HaiYan, "Notice of Retraction: Cockroach Swarm Optimization," 2010 2nd International Conference on Computer Engineering and Technology, Chengdu, 2010, pp. V6-652-V6-655. doi: 10.1109/ICCET.2010.5485993

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5485993&isnumber=5485932>

Killer Whale Algorithm	(Biyanto et al., 2017)
Kinetic Gas Molecule Optimization	(Moein and Logeswaran, 2014)
Krill Herd	(Gandomi and Alavi, 2012)
Laying Chicken Algorithm	(Hosseini, 2017)
Lion Optimization Algorithm	(Yazdani and Jolai, 2016)
Lion Pride Optimizer	(Wang, Jin and Cheng, 2012)
Locust Swarms	(Chen, 2009a)
Magnetotactic Bacteria Optimization Algorithm	(H. Mo and L. Xu, 2013)
Meerkat-inspired Algorithm	(Klein and dos Santos Coelho, 2018)
Migrating Birds Optimization	(Duman, Uysal and Alkaya, 2011)
Monarch Butterfly Optimization	(Wang, Deb and Cui, 2015)
Monkey Algorithm	(Zhao and Tang, 2008)
Mosquito flying optimization	(M. Alauddin, 2016)
Mosquitos Oviposition	(Minhas and Arif, 2011)
Mouth Brooding Fish algorithm	(Jahani and Chizari, 2018)
Mussels Wandering Optimization	(An et al., 2013)
Ohm's Law Optimization algorithm	(Fadafen et al., 2019)
OptBees	(R. D. Maia, L. N. de Castro and W. M. Caminhas, 2012)
Paddy Field Algorithm	(Premaratne, Samarabandu and Sidhu, 2009)
Pastoralist Optimization Algorithm	(Abdullahi et al., 2018)
Penguins Search Optimization Algorithm	(Gheraibia and Moussaoui, 2013)
Pity Beetle Algorithm	(Kallioras, Lagaros and Avtzis, 2018)
Prey-Predator Algorithm	(Tilahun and Ong, 2013)
Raccoon Optimization Algorithm	(S. Zangbari Koochi et al., 2019)
Raven Roosting Optimisation Algorithm	(Brabazon, Cui and O'Neill, 2016)
Red Deer Algorithm	(Fard and Hajiaghaei-Keshteli, 2016)
Roach Infestation Optimization	(T. C. Havens et al., 2008)
Root Growth Algorithm	(Zhang, Zhu and Chen, 2014)
Root Mass Optimization	(Qi et al., 2013)
Sea Lion Optimization Algorithm	(Masadeh, 2019)
See-See Partridge Chicks Optimization	(R. Omidvar, H. Parvin and F. Rad, 2015)
Selfish Herd Optimizer	(Fausto et al., 2017)
Seven-spot Ladybird Optimization	(Wang, Zhu and Huang, 2013)
Social Spider Optimization	(Cuevas et al., 2013)
Sonar Inspired Optimization	(Tzanetos and Dounias, 2017)
Spider Monkey Optimization Algorithm	(Bansal et al., 2014)
Spiral Dynamics Algorithm	(Nasir et al., 2013)
Spring Search Algorithm	(M. Dehghani et al., 2017)
States of Matter	(Cuevas, Echavarría and Ramírez-Ortegón, 2014)
Stem Cells Optimization Algorithm	(Taherdangkoo, Yazdi and Bagheri, 2012)
Supernova Optimizer	(Hudaib and Fakhouri, 2017)
Swallow Swarm Optimization Algorithm	(Neshat, Sepidnam and Sargolzaei, 2013)
Termite Colony Optimization	(Hedayatzadeh et al., 2010)
The Bees Algorithm	(Pham et al., 2006)
The Great Salmon Run	(Mozaffari, Fathi and Behzadipour, 2012)
The Lion's Algorithm	(Rajakumar, 2012)
Tree Based Optimization	(Ghojogh, Sharifian and Mohammadzade, 2018)
Vapour-liquid Equilibrium-based Algorithm	(Cortés-Toro et al., 2018)
Virulence Optimization Algorithm	(Jaderyan and Khotanlou, 2016)
Vortex Search Algorithm	(Doğan and Ölmez, 2015)
Weightless Swarm Algorithm	(Ting et al., 2012)
Whale Swarm Algorithm	(Zeng, Gao and Li, 2017)
Wolf Pack Algorithm	(Wu and Zhang, 2014)
Wolf Search	(Tang et al., 2012)
Yellow Saddle Goatfish	(Zaldívar et al., 2018)

Nature Inspired Algorithms applied on real world problems in the work that were presented

In Figure 1 above, approximately half of all the Nature Inspired Algorithms have been applied on a real world application in their first appearance. These applications are classified in the Tables below.

First of all, the majority of the algorithms which had an application in their initial work are applied in engineering design problems, such as welded beam design, pressure vessel design, airfoil design and truss structure design.

Table 3: Algorithms that were tested on engineering applications

Algorithm	Reference
African Wild Dog Algorithm	(Subramanian, Sekar and Subramanian, 2013)
Ant Lion Optimizer	(Mirjalili, 2015b)
Artificial Algae Algorithm	(Uymaz, Tezel and Yel, 2015)
Artificial Coronary Circulation System	(Kaveh and Kooshkebaghi, 2019)
Artificial Plant Optimization Algorithm	(Z. Zhao et al., 2011)
Bacterial Chemotaxis	(Muller et al., 2002)
Beetle Swarm Optimization Algorithm	(Wang, Yang and Liu, 2018)
Biogeography-based Optimization	(Simon, 2008)
Biology Migration Algorithm	(Zhang et al., 2018)
Black Widow Optimization	(Hayyolalam and Pourhaji Kazem, 2020)
Central Force Optimization	(Formato, 2007)
Charged System Search	(Kaveh and Talatahari, 2010)
Chicken Swarm Optimization	(Meng et al., 2014)
Colliding Bodies Optimization	(Kaveh and Mahdavi, 2014)
Cyclical Parthenogenesis Algorithm	(Kaveh and Zolghadr, 2017)
Crow Search Algorithm	(Askarzadeh, 2016)
Dolphin Echolocation	(Kaveh and Farhoudi, 2013)
Dragonfly Algorithm	(Mirjalili, 2016a)
Eagle Perching Optimizer	(Khan et al., 2018)
Emperor Penguin Optimizer	(Dhiman and Kumar, 2018)
Falcon Optimization Algorithm	(Vasconcelos Segundo, Mariani and Santos Coelho, 2019)
Flow Regime Algorithm	(Tahani and Babayan, 2018)
Flower Pollination Algorithm	(Yang, 2012)
Flying Squirrel Optimizer	(Azizyan et al., 2019)
General Relativity Search Algorithm	(Beiranvand and Rokrok, 2015)
Grasshopper Optimization Algorithm	(Mirjalili et al., 2018)
Grey Wolf Optimizer	(Mirjalili, Mirjalili and Lewis, 2014)
Harris Hawks Optimization	(Heidari et al., 2019)
Henry Gas Solubility Optimization	(Hashim et al., 2019)
Honey-bees Mating Optimization	(Haddad, Afshar and Mariño, 2006)
Ideal Gas Molecular Movement Algorithm	(Varaee and Ghasemi, 2017)
Lion Pride Optimization Algorithm	(Kaveh and Mahjoubi, 2018)
Mine Blast Optimization	(Sadollah et al., 2012)
Moth Flame Optimization	(Mirjalili, 2015a)
Multi-verse Optimizer	(Mirjalili, Mirjalili and Hatamlou, 2016)
Mushroom Reproduction Optimization	(M. Bidar et al., 2018)
Natural Forest Regeneration	(Moez, Kaveh and Taghizadieh, 2016)
Neuronal Communication	(Asil Gharebaghi and Ardalan Asl, 2017)
Nuclear Reaction Optimization	(Z. Wei et al., 2019)
Optics Inspired Optimization	(Husseinzadeh Kashan, 2015)

Particle Collision Algorithm	(Sacco and Oliveira, 2005)
Polar Bear Optimization Algorithm	(Połap and Wozniak, 2017)
Ray Optimization	(Kaveh and Khayatazad, 2012)
Sailfish Optimizer	(Shadravan, Naji and Bardsiri, 2019)
Salp Swarm Algorithm	(Mirjalili et al., 2017)
Seagull Optimization Algorithm	(Dhiman and Kumar, 2019)
Seed-based Plant Propagation Algorithm	(Sulaiman and Salhi, 2015)
Sine Cosine Algorithm	(Mirjalili, 2016b)
Sooty Tern Optimization Algorithm	(Dhiman and Kaur, 2019)
Space Gravitational Algorithm	(Hsiao et al., 2005)
Space Gravity Optimization	(Kılınç, Mahouti and Güneş, 2013)
Sperm Whale Algorithm	(Ebrahimi and Khamehchi, 2016)
Spotted Hyena Optimizer	(Dhiman and Kumar, 2017)
Stochastic Fractal Search	(Salimi, 2015)
Symbiotic Organisms Search	(Cheng and Prayogo, 2014)
Thermal Exchange Optimization	(Kaveh and Dadras, 2017)
Vibrating Particles System Algorithm	(Kaveh and Ilchi Ghazaan, 2017)
Virus Colony Search	(Li et al., 2016)
Water Cycle Algorithm	(Eskandar et al., 2012)
Water Evaporation Optimization	(Kaveh and Bakhshpoori, 2016)
Whale Optimization Algorithm	(Mirjalili and Lewis, 2016)
Whirlpool Algorithm	(Zou, 2019)
Wind Driven Optimization	(Z. Bayraktar, M. Komurcu and D. H. Werner, 2010)

From the field of Operation Research (OR), there are a few schemes that are proposed to solve The Traveling Salesman Problem (TSP) or the Vehicle Rooting Problem (VRP).

Table 4: Algorithms that were proposed to solve TSP or VRP

Algorithm	Reference
African Buffalo Optimization	(Odili and Kahar, 2015)
Bee Collecting Pollen Algorithm	(Lu and Zhou, 2008)
Bee Colony Optimization	(Teodorovic and Dell'Orco, 2005)
Bumble Bees Mating Optimization	(Marinakis and Marinaki, 2011)
Chemotherapy Science Algorithm	(Salmani and Eshghi, 2017)
Crystal Energy Optimization Algorithm	(Feng, Ma and Yu, 2016)
Donkey and Smuggler Optimization Algorithm	(Shamsaldin et al., 2019)
Green Herons Optimization Algorithm	(Sur and Shukla, 2013)
Intelligent Water Drop	(Hosseini, 2007)
Lightning Search Algorithm	(Shareef, Ibrahim and Mutlag, 2015)
Meerkat Clan Algorithm	(Al-Obaidi, Abdullah and Ahmed, 2018)
Physarum-energy Optimization Algorithm	(Feng et al., 2019)
Reincarnation Algorithm	(A. Sharma, 2010)
River Formation Dynamics	(Rabanal, Rodríguez and Rubio, 2007)

What is more, other problems that belong to the OR field are solved by some NIAs in their proposed form. Such problems are the Knapsack problem, scheduling problems, the assignment problem and the satisfiability problem (SAT).

Table 5: Algorithms that were tested on other Operational Research problems

Algorithm	Reference
Knapsack Problem	
Egyptian Vulture Optimization Algorithm	(Sur, Sharma and Shukla, 2013)
Scheduling Problems	
Superbug Algorithm	(Anandaraman, Madurai Sankar and Natarajan, 2012)
Rhinoceros Search Algorithm	(Deb et al., 2018)
Vocalization of Humpback Whale Optimization Algorithm	(Masadeh, Sharieh and Mahafzah, 2019)
Water Wave Optimization	(Zheng, 2015)
Waterweeds Algorithm	(Cheng et al., 2016)
Assignment Problems	
Barnacles Mating Optimizer	(Sulaiman et al., 2018)
Jumper Firefly Algorithm	(M. Bidar and H. Rashidy Kanan, 2013)
Assignment Problem & Scheduling Problem	
Chemical-reaction-inspired Optimization	(Lam and Li, 2010)
Satisfiability Problems	
Marriage in Honey Bees	(Abbass, 2001)

Another very common field of problems that NIAs cope with in literature is energy problems. In this field, Economic Load Dispatch (ELD), Optimal Power Flow (OPF), Quanser Heat Flow Experiment, Load Frequency Control, Heat Flow Experiment and Solar PV Array are met.

Table 6: Algorithms that were tested on energy problems

Algorithm	Reference
Coulombs Franklins Algorithm	(Ghasemi et al., 2018)
Owl Search Algorithm	(Jain et al., 2018)
Pontogammarus Maeoticus Swarm Optimization	(Ghojogh and Sharifian, 2018)
Rainfall Optimization Algorithm	(Aghay Kaboli, Selvaraj and Rahim, 2017)
Root Tree Optimization Algorithm	(Labbi et al., 2016)
Shark Smell Optimization	(Abedinia, Amjady and Ghasemi, 2016)
Squirrel Search Algorithm	(Jain, Singh and Rani, 2019)

A few works include multiple applications, on which the proposed algorithms were tested.

Table 7: Algorithms with multiple applications

Algorithm	Reference
Artificial Ecosystem-based Optimization	(Zhao, Wang and Zhang, 2019a)
❖ Engineering design problems	
❖ Identification of Hydrogeological Parameters	
Artificial Feeding Birds	(Lamy, 2019)
❖ Train Artificial Neural Networks	
❖ TSP	
❖ Optimization of rainbow boxes	
Clonal Selection Algorithm	(de Castro and von Zuben, 2000)
❖ Binary character recognition	
❖ TSP	
Coral Reefs Optimization Algorithm	(Salcedo-Sanz et al., 2014)
❖ TSP	
❖ Mobile Network deployment problem	
❖ Design of Off-shore wind farms	
Gases Brownian Motion Optimization	(Abdechiri, Meybodi and Bahrami, 2013)
❖ Satisfiability problem (SAT)	
❖ Potential problems	
Harmony Search	(Geem, Kim and Loganathan, 2001)
❖ TSP	
❖ Engineering design problems	
Lightning Attachment Procedure Optimization	(Nematollahi, Rahiminejad and Vahidi, 2017)
❖ Engineering design problems	
❖ Optimal Power Flow (OPF)	
Physarum Optimization	(Song et al., 2012)
❖ Minimal exposure problem	
❖ Steiner Tree problem	
Simulated Annealing	(Kirkpatrick, Gelatt and Vecchi, 1983)
❖ Placement wiring	
❖ TSP	
Tree Growth Algorithm	(Cheraghalipour, Hajiaghaei-Keshteli and Paydar, 2018)
❖ Engineering design problems	
❖ Scheduling problem	
❖ TSP	

The rest of the algorithms that were applied on different problems are collected and presented in Table 8 below.

Table 8: Other applications that NIAs were tested on

Algorithm	Problem	Reference
Andean Condor Algorithm	Cell Formation Problems	(Almonacid and Soto, 2019)
Artificial Raindrop Algorithm	Stable Linear System	(Jiang et al., 2014)
Artificial Social Cockroaches	Suspicious Person Detection	(Bouarara, Hamou and Amine, 2015)
Atom Search Optimization	Hydrogeological Parameter Estimation Problem	(Zhao, Wang and Zhang, 2019b)
Black Hole	Clustering	(Hatamlou, 2013)
Bumblebees	Coloring Graph	(Comellas and Martinez-Navarro, 2009)
Cockroach Colony Optimization	Robot navigation	(Cheng et al., 2015)
Dolphin Pod Optimization	Hull-form SBD	(Serani and Diez, 2017)
Dominion Algorithm	N-Queens Problem	
Earthworm Optimization Algorithm	TSC problem	(Wang, Deb and Coelho, 2015b)
Electrostatic Discharge Algorithm	EMC filter	(H. R. E. H. Bouchekara, 2019)
Eurygaster Algorithm	Graph Partitioning	(Ahmadi, Salehi and Karimi, 2012)
Fish Electrolocation Optimization	Reliability	(Haldar and Chakraborty, 2017)
Forest Optimization Algorithm	Clustering	(Ghaemi and Feizi-Derakhshi, 2014)
Galaxy-based Search Algorithm	Principal Components Analysis	(Shah-Hosseini, 2011)
Jumping Frogs Optimization	p-Median Problem	(Garcia and Pérez, 2008)
Military Dog Optimizer	Fake Review Detection	(Tripathi, Sharma and Bala, 2019)
Monkey Search	Potential problems	(Mucherino and Seref, 2007)
Particle Swarm Optimization	Train ANN	(Eberhart and Kennedy, 1995)
Pigeon-inspired Optimization	Air Robot Path Planning Problem	(Qiao and Duan, 2014)
Plant Growth Optimization	Speed reducer problem	(W. Cai, W. Yang and X. Chen, 2008)
Plant Propagation Algorithm	Chlorobenzene Purification Process Design	(Salhi and Fraga, 2011)
Runner-root Algorithm	Robust Control Theory	(Merrikh-Bayat, 2015)
Satin Bowerbird Optimizer	Software Development Effort Estimation	(Samareh Moosavi and Khatibi Bardsiri, 2017)
Shuffle frog-leaping Algorithm	Groundwater Model Calibration	(Eusuff, Lansey and Pasha, 2006)
Stochastic Diffusion Search	Pattern Recognition	(Bishop and Torr, 1992)
Swine Influenza Models Based Optimization	Motion Estimation	(Pattnaik et al., 2013)
Tree Seed Algorithm	Image Thresholding	(Kiran, 2015)
Viral Systems	The Steiner problem	(Cortés et al., 2008)
Wildebeests Herd Optimization	Customer Segmentation Problem	(Motevali et al., 2018)
Zombie Survival Optimization	Image Tracking	(Nguyen and Bhanu, 2012)

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