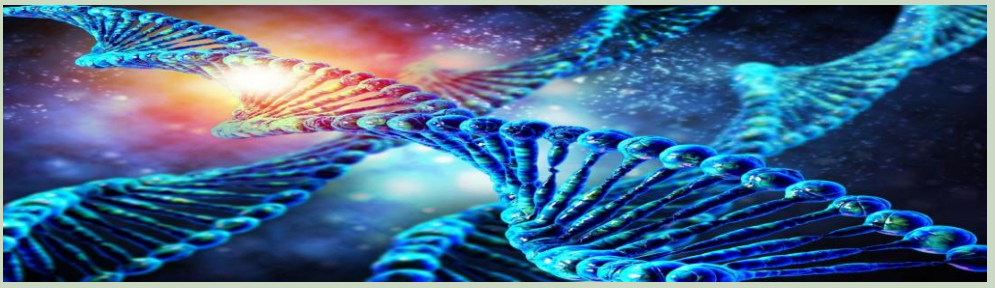
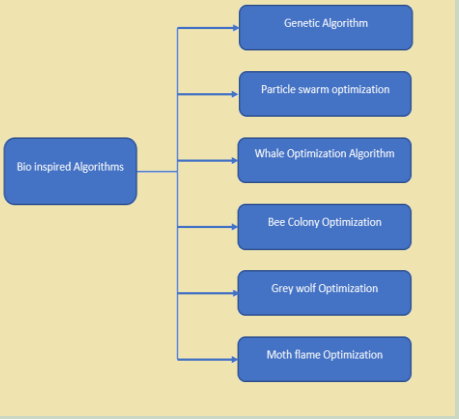
FINITE ELEMENT MODELLING RESEARCH GROUP

Usama Hamid, Magd Abdel Wahab

BIO-INSPIRED ALGORITHMS FOR ENGINEERING PROBLEMS

Bio-inspired optimization algorithms are computational methods that take inspiration from natural processes, such as evolution, genetics, and behaviour of animals, to solve complex optimization problems. These algorithms are designed to mimic the way biological systems adapt and evolve over time, in order to find optimal solutions to difficult optimization problems.



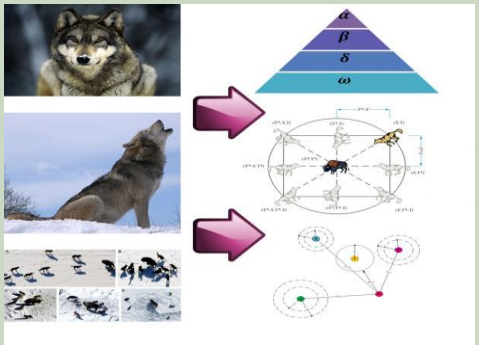


Various Bio inspired algorithms

The bio inspired algorithms works on the movement and preying tactics of animals/insects. The important features of animals such as movement, direction and foraging, hunting can be employed for exploration and exploitation of search spaces.

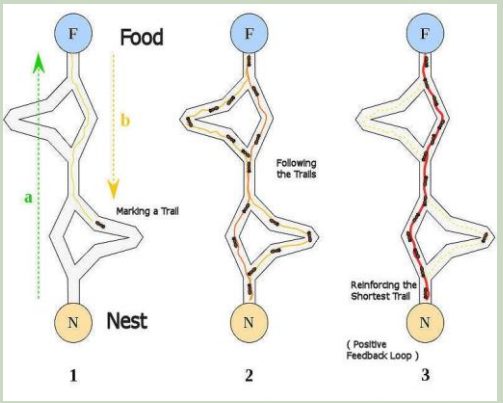
Hunting-based algorithms:

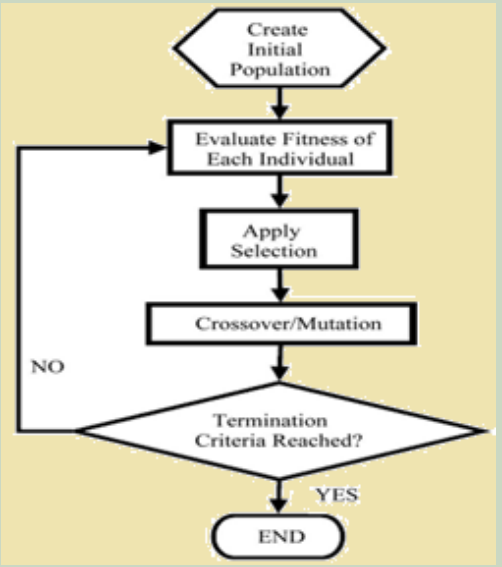
These algorithms are inspired by the hunting behaviour of predators such as lions, wolves, and eagles. The strategy employed by selecting a target, assess fitness, move towards target and repeat process until satisfactory solution is found.



Foraging-based algorithms:

These algorithms are inspired by the foraging behaviour of animals such as bees, ants, and birds. The strategy works by scouting for food, evaluating the quality of food, return to nest and share of information until satisfactory solution is obtained.





Flow chart of bio inspired algorithm

In most bio inspired algorithms the position and velocity are updated based of animal/insect movement. These ensure to find the optimum solution and help is exploration and exploitation of search space. Common update equations are:

$$v_i^{t+1} = wv_i^t + C_1 r_1 (P_{best}^i - X_i^t) + C_2 r_2 (g_{best} - X_i^t)$$

$$X_i^{t+1} = X_i^t + v_i^{t+1}$$

Applications:

1) Structural design optimization
2) Agriculture
3) Transportation
4) Industrial Applications
5) Computer science

Conclusions

Bio-inspired algorithms are a powerful class of computational methods that are widely used to solve complex optimization problems. As research in this area continues, we can expect to see more innovative and effective bio-inspired algorithms developed to solve increasingly complex problems.

References

1) Gilberto C. Pereira, Marilia M. F. de Oliveira*, Nelson F. F. Ebecken. Genetic Optimization of Artificial Neural Networks to Forecast Virioplankton Abundance from Cytometric Data. Journal of Intelligent Learning Systems and Applications. Vol. 5 No. 1 (2013) , Article ID: 28065.
2) Seyedali Mirjalili, Andrew Lewis. Frey wolf optimizer. Advances in engineering software Volume 69, March 2014, Pages46-61.
3) Marco Dorigo, Thomas Stützle. European Journal of Operational Research. Volume 168, Issue 1, 1 January 2006, Pages 269-271.

Contact

Usama.Hamid@ugent.be
www.ugent.be/ea/eemmecs/en/research/soete

Universiteit Gent
@ugent
Ghent University