

Grasshopper Optimization Algorithm (GOA)

A **Novel** Algorithm ?
OR
A **Variant** of PSO ?



EVALUATING THE SIMILARITY BETWEEN ALGORITHMS

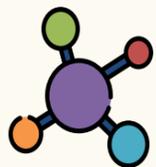


PSO VARIANTS



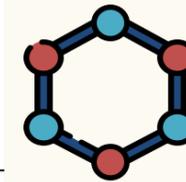
SPSO

Each particle has information about its personal best and the local best particle in its neighborhood.



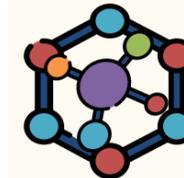
Bare-bone PSO

Uses all the information in the swarm instead of just the global best and centers the particles around the average of the best position.



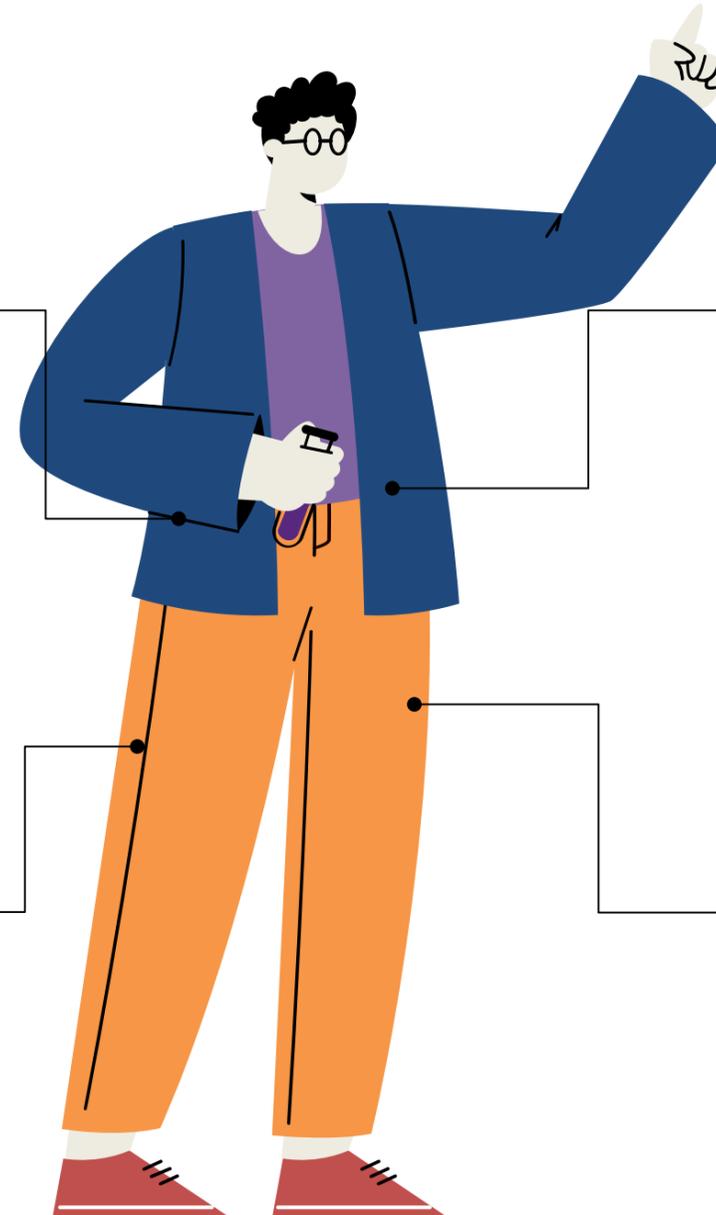
FiPSO

Uses the position of all particles and not just the best one, making the particles “fully informed”.



BBFiPSO

A BBPSO variant that uses all the information in the swarm instead of just the global best.



GRASSHOPPER OPTIMIZATION ALGORITHM (GOA)

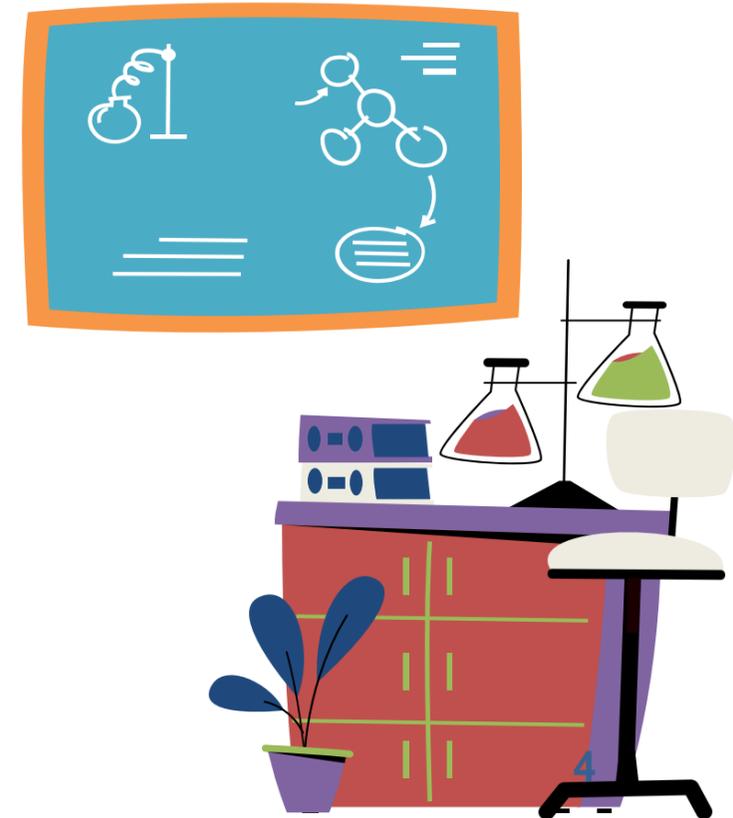
“The algorithm operates with a population of grasshoppers in a swarm to optimize solutions to various problems.”



$$x_i^{t+1} = c_t^2 \frac{u-l}{2} \odot \left(\sum_{\substack{j=1 \\ j \neq i}}^N S(\|x_j^t - x_i^t\|) \frac{x_j^t - x_i^t}{d_{ij}} \right) + g^t$$

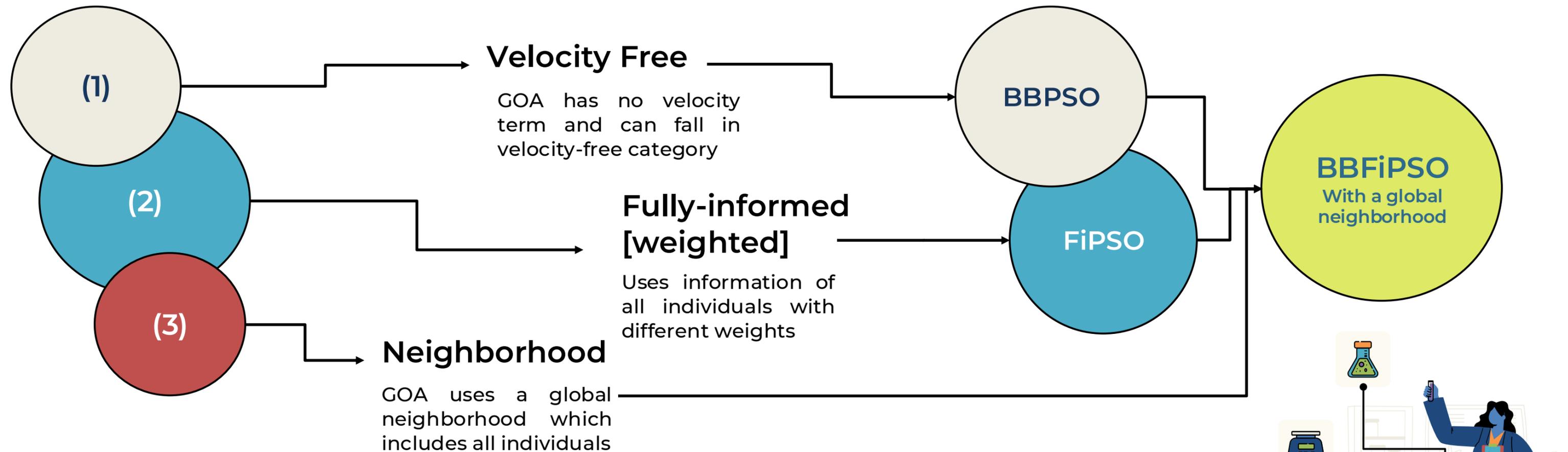
$$S(d) = f \exp(-d/a) - \exp(-d)$$

- g_t The best solution found by the grasshoppers at iteration t
- c_t Decreases linearly over T timesteps from a value c_{max} to c_{min}
- u, l Upper bound and lower bound of the position vector
- d_{ij} The Euclidean distance between the grasshoppers i and j ($d_{ij} = \|x_j^t - x_i^t\|$)
- S The social interaction function that modulates the attractive behavior of the swarm ($S(d) > 0$) versus the repelling behavior ($S(d) < 0$)



HOW DOES GOA COMPARE TO PSO?

$$x_i^{t+1} = c_t^2 \frac{u-l}{2} \odot \left(\sum_{\substack{j=1 \\ j \neq i}}^N S(\|x_j^t - x_i^t\|) \frac{x_j^t - x_i^t}{d_{ij}} \right) + g^t \quad \left| \quad S(d) = f \exp(-d/a) - \exp(-d) \right.$$

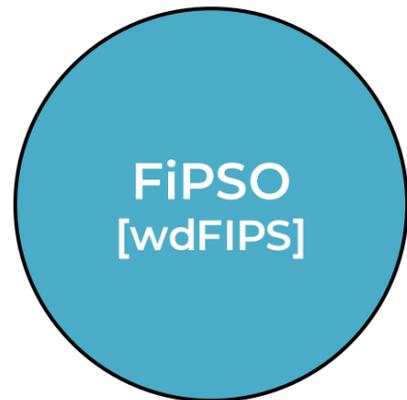


HOW DOES GOA COMPARE TO PSO?



$$x_i^{t+1} = g^t + \alpha m_i^t \gamma$$

- m_i^t Reflects the contribution of each neighboring particle by its distance to the target particle
- γ A random number drawn from the standard normal distribution $N(0,1)$
- α A positive constant that effects the convergence rate



$$m_i^t = \sum_{k=1}^N W_{ki}^t \frac{\varphi(x_k^t - x_i^t)}{N}$$

- W_{ki}^t Weights determining the contribution of particle k to the position of particle i
- φ A random number drawn from the uniform distribution

BBFiPSO

Turning the stochastic problem to a deterministic one and defining weights as follows:

$$W_{ki}^t = \frac{S(\|x_k^t - x_i^t\|)}{d_{ik}}$$



$$x_i^{t+1} = g^t + \frac{\alpha\beta}{N} \sum_{k=1}^N S(\|x_k^t - x_i^t\|) \frac{(x_k^t - x_i^t)}{d_{ik}}$$

GOA is a PSO Variant



PERFORMANCE COMPARISON

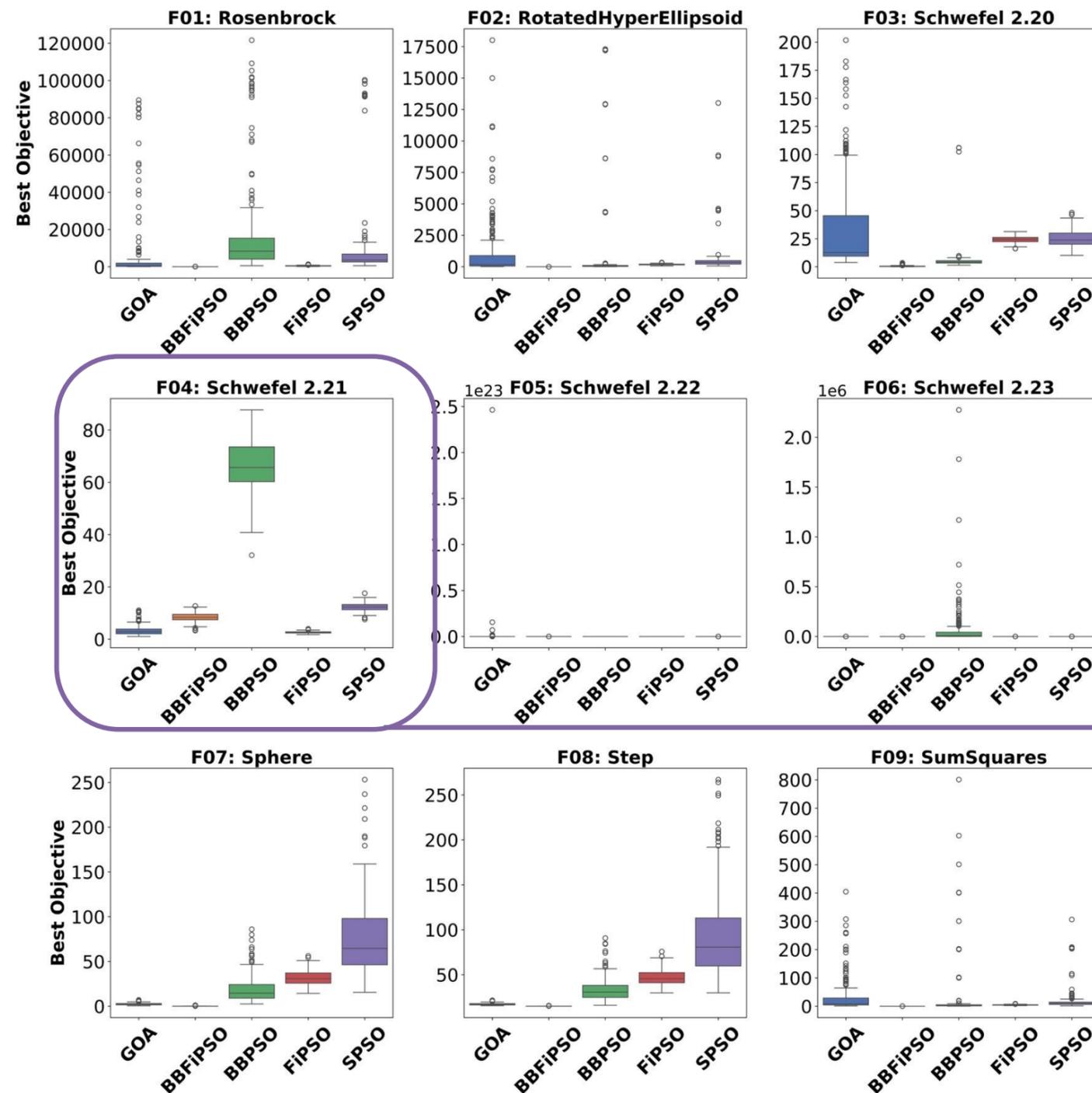
Unimodal Benchmark Functions

Experimental Setup



Parameter	Value
Independent Runs	200
No. Of Iterations	150
No. Of Dimensions	30
No. Of Individuals	100
Topology	Fully Connected
Neighborhood	Global

The values of the parameters follow their definition in the papers that they were drawn from.



Conclusions



All functions except F04
No significant improvement in terms of effectiveness between GOA and BBFiPSO ($p = 1$)
OR
BBFiPSO outperforms GOA

F04
No significant improvement in terms of effectiveness between GOA and FiPSO ($p = 0.998$)



PERFORMANCE COMPARISON

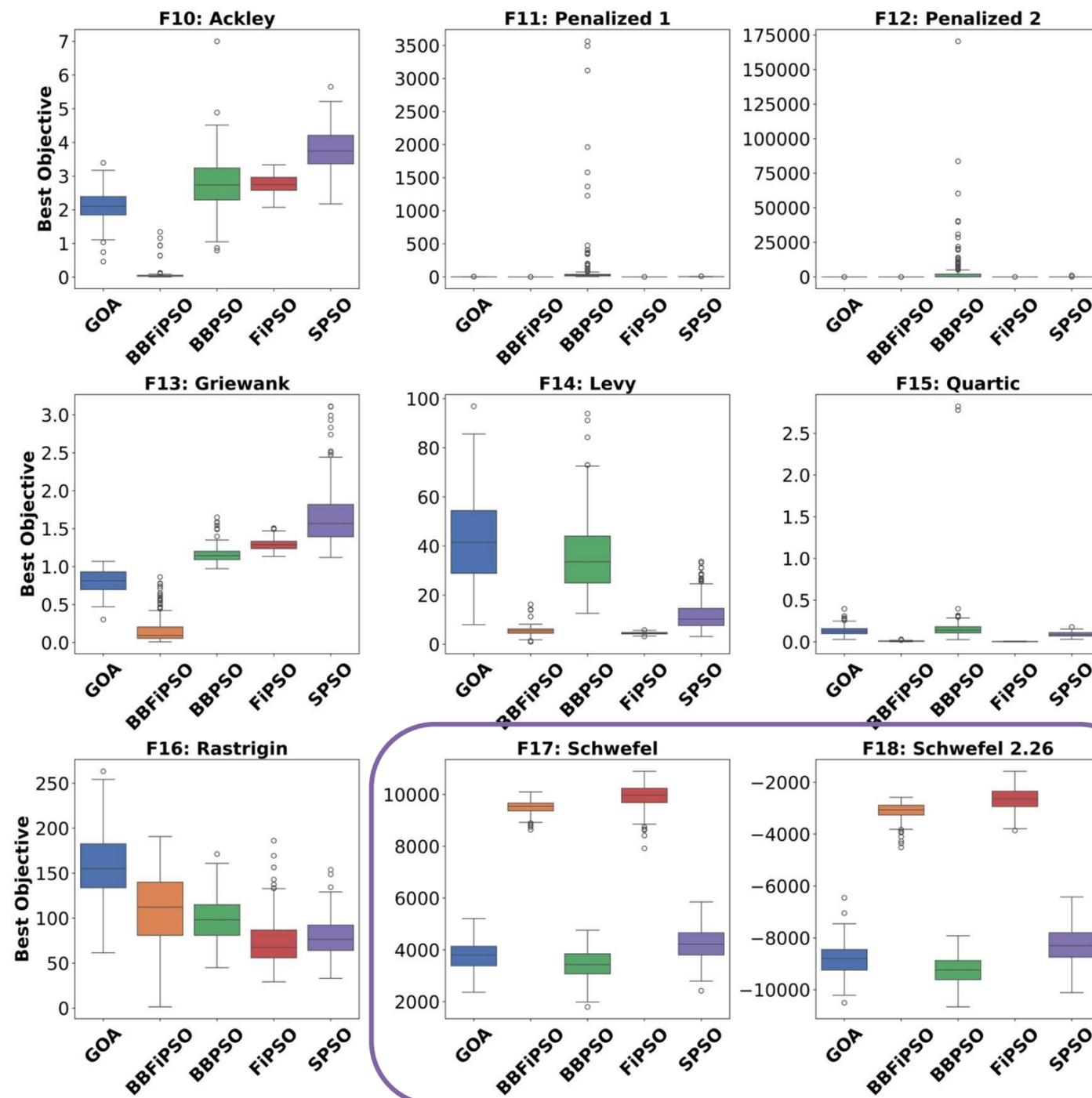
Multimodal Benchmark Functions

Experimental Setup



Parameter	Value
Independent Runs	200
No. Of Iterations	150
No. Of Dimensions	30
No. Of Individuals	100
Topology	Fully Connected
Neighborhood	Global

The values of the parameters follow their definition in the papers that they were drawn from.



Conclusions



F10 to F16

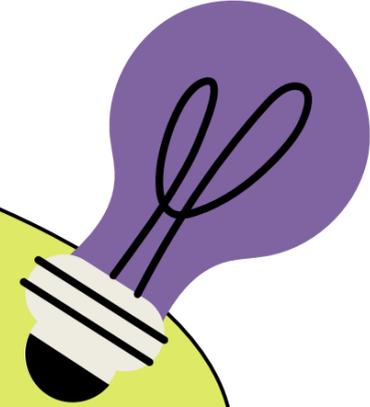
No significant improvement in terms of effectiveness between GOA and BBFiPSO ($p = 1$)
OR
BBFiPSO outperforms GOA

F17 and F18

No significant improvement in terms of effectiveness between GOA and BBPSO ($p = 1$)



**GOA is a Variant of PSO
and
NOT a NOVEL algorithm**





**THANK YOU
FOR
YOUR ATTENTION**



Q&A

Do you have any questions?

Negin.Harandi@Ghent.ac.kr

CENTRE FOR BIOSYSTEMS AND BIOTECH DATA SCIENCE,
DEPARTMENT OF ENVIRONMENTAL TECHNOLOGY, FOOD TECHNOLOGY AND
MOLECULAR BIOTECHNOLOGY
GHENT UNIVERSITY GLOBAL CAMPUS, SOUTH KOREA

Negin.Harandi@Ugent.be

DEPARTMENT OF APPLIED MATHEMATICS, COMPUTER SCIENCE AND STATISTICS
GHENT UNIVERSITY, BELGIUM

