

1. In general, what is a phenomenological model?

2. Regarding the interpretation of the particle (individual) positions \mathbf{x}_i , what is the main difference between PSO and GAs?

3. In PSO, both velocities and positions are restricted to a given range.

TRUE FALSE

1. A phenomenological model is a model that can describe (or reproduce) a phenomenon (such as, for example, swarming) on some level, but without providing a detailed theoretical understanding of the phenomenon. For example, the Boids model can reproduce the behavior of swarms but it does not, for example, give detailed information about the decision-making (on the level of neurons) in the brains of the birds. (Note: In addition to this definition, it should be mentioned that the term *phenomenological model* is also used in the field of psychology, where it carries a different meaning).

2. In PSO, one has the notion of a *velocity* in the search space, i.e. a smooth, continuous movement from a given position to another. This is not the case in GAs, where the movement in search space is generated by crossover and mutation.

3. This is FALSE: Only the velocities are restricted. Doing so is crucial for maintaining the coherence of the swarm, i.e. for preventing particles from being ejected from the swarm. However, there is no need to restrict positions. Indeed, the fact that positions are not restricted is an advantage of PSO (relative to GAs, for example), in the sense that, in PSO, particles can venture a bit outside the initial range (while still avoiding to leave the swarm entirely, due to the velocity restriction).