
Particle Swarm Optimization: a parallelized approach

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1 Abstract

Particle Swarm Optimization is an optimization algorithm for nonlinear function based on birds swarm. It falls back into the sub-field of *Bio-Inspired Artificial Intelligence* and it was designed from a simplified social model inspired from the nature.

A key concept associated with PSO is the role of genetic algorithms and evolution, the functioning is based on several iterations that aim to identify the best possible position represented as a point in a landscape (Figure 1).

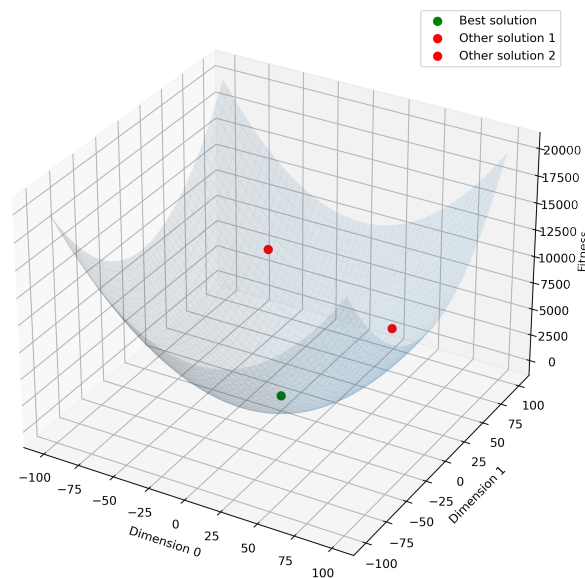


Figure 1: Solution landscape with best possible solution represented in green

PSO is originally attributed to James Kennedy and Russell Eberhart and was first intended for simulating social behaviour in 1995.

The goal of this project is to design a parallelized implementation capable of exploring the solution space in a faster way. This is done through the usage of two main libraries for *High Performance Computing (HPC)*: *OpenMPI* and *OpenMP*.

The effectiveness of the proposed solution is tested using the HPC cluster of the University of Trento among other implementations found online.

2 Introduction

2.1 OpenMPI

OpenMPI library is used to convey information across processes running on different nodes of a cluster. The basic information unit is composed as a broadcast message shared over the whole network, in this way all particles of Particle Swarm Optimization (PSO) are able to know all information associated to other members of the swarm.

The process that produces the message sends the message using a gather function because all particles must know the positions of other individuals of the population at every step. In the following picture it is presented a simple schema of the communication.

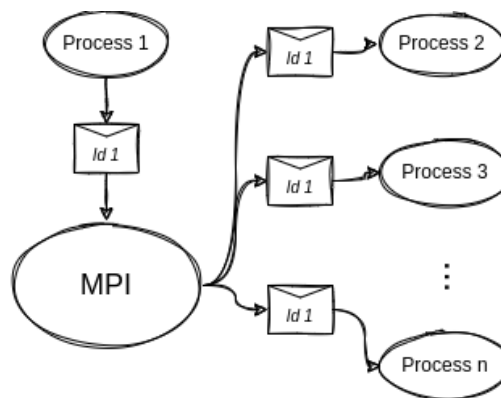


Figure 2: Communication schema

2.2 Process

A process can have the task of computing the algorithm for one or more particles, it is divided in several threads that optimize the execution time of the process.

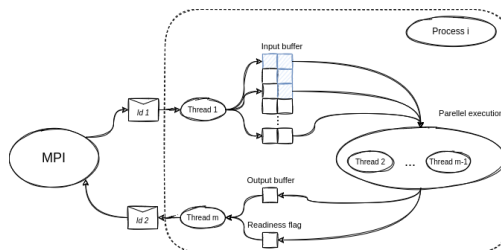


Figure 3: Execution schema