TREE-SEED ALGORITHM

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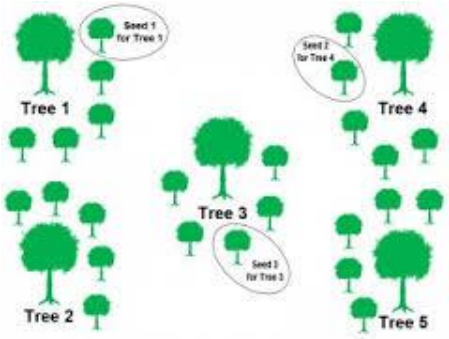
Outline of Presentation

- Tree-Seed Algorithm
  - Motivation and representation
  - A brief history of studies on TSA.
  - Trees and Seed Production
  - Control Parameters
  - Working Diagram of TSA
- TSA Variants
  - Continuous
  - Binary
  - Discrete

Tree-Seed Algorithm (TSA)



- TSA is a population-based iterative search algorithm.
- TSA is inspired the natural life cycle of trees.
- The seed production is an important part of TSA because the search is performed by the seeds.
- Trees and seeds in stand of TSA correspond potential solutions for the optimization problem.
- If the problem has ***n*** different decision/design variables, the trees and seeds lives on *n*-dimensional space.

A brief history of studies on TSA.

- Tree-Seed Algorithm (TSA) is a population-based heuristic search algorithm recently proposed to solve continuous optimization problems [1].(2015)
- It is modified for solving contrained optimization problems [2].(2016)
- Zheng et al. [3] used it to design of a multi-mode intelligent model predictive control strategy for hydroelectric generating unit. (2016)
- A parallel version of TSA within Cuda platform is developed by Cinar [4]. (2016)
- Muneeswaran and Rajasekaran [5] used it to train radial basis function networks. (2016)
- …

Trees and Seed Production

- The potential solutions for the optimization problem are represented by locations of trees and seeds.
- Generating a certain number of trees (size of stand, population size etc.) is as follows:

$$T_{i,j} = X_j^{\min} + r_{i,j} \times (X_j^{\max} - X_j^{\min})$$

$$i = 1, 2, \ldots, N \;\; and \;\; j = 1, 2, \ldots, D$$

Seed production (1/3)

- In TSA, seeds are used for searching solution space to find optimal or near optimal solution.
- The number of seeds which will be produced for a tree depends on the size of stand and it is chosen in range of 10% and 25% of stand size.
- When N is 40, the number of seeds for each tree is an integer in range of [4,10].
- To create a seed for a tree, either best solution obtained so far or current tree is used with a random tree in equation given in next slide.

(2/3)

$$S_{k,j} = T_{i,j} + \alpha_{i,j} \times (B_j - T_{r,j})$$

$$S_{k,j} = T_{i,j} + \alpha_{i,j} \times (T_{i,j} - T_{r,j})$$

jth dimension of ith tree

jth dimension of the best solution obtained so far

jth dimension of kth seed for Tij

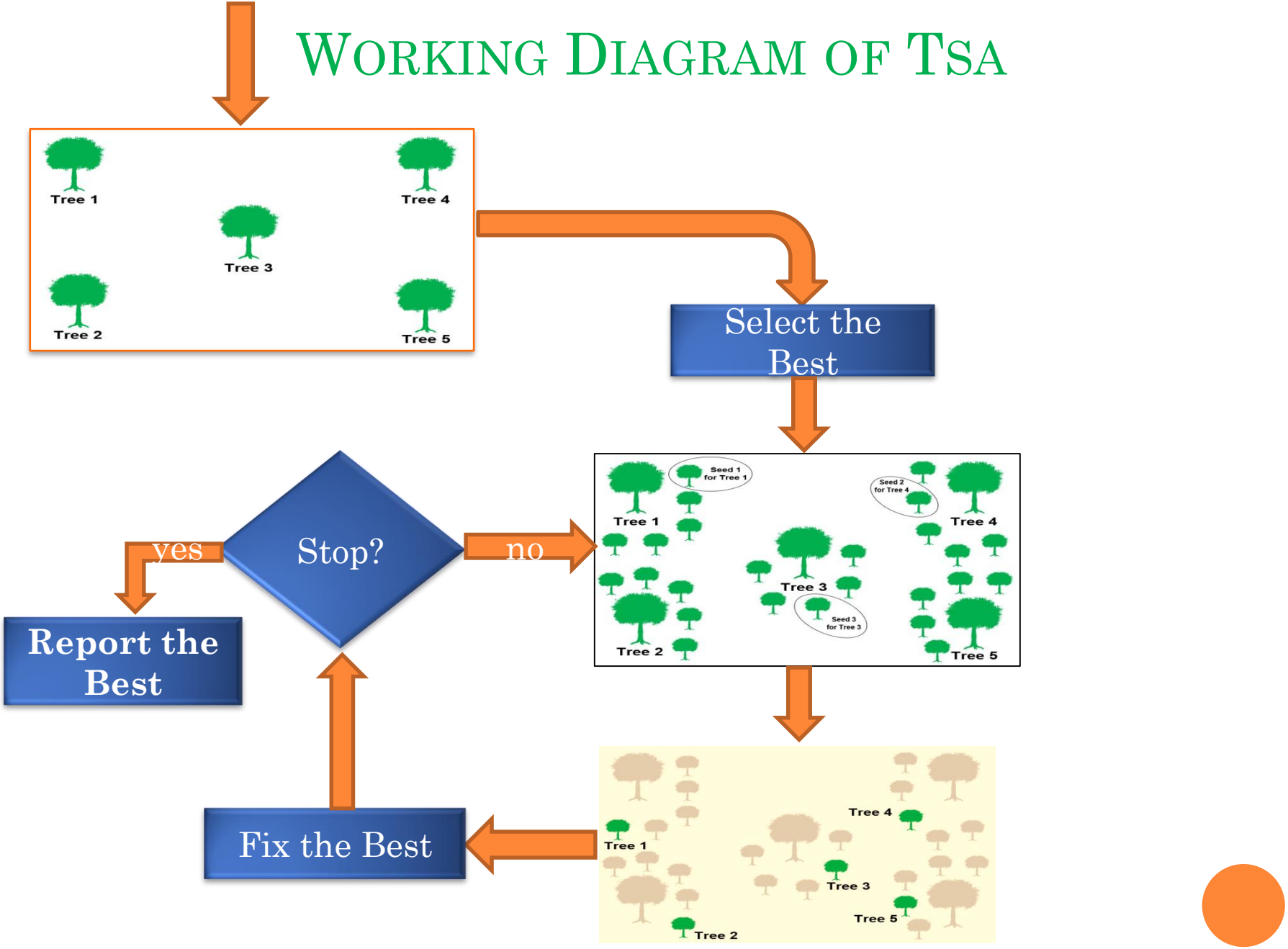
scaling factor in range of [-1,1]

jth dimension of a tree randomly selected from the stand

(3/3)

- First equation provides to approach to best solution so it improves the convergence characteristics of TSA. Second equation provides a random search around the current tree.
- Which equation is selected for generation of the dimension of seed depends on a control parameter of TSA, named as search tendency-ST.
- ST is selected in range of [0,1]. If it is selected as 0, the second equation is always selected. Otherwise the best tree is selected. In the basic study of TSA, the ST is analyzed and it is shown that 0.1 is appropriate value for this parameter.

Working Diagram of TSA



Variants of TSA

- Binary and Discrete versions of Tree-Seed Algorithm (Phd Thesis: Ahmet Cevahir Cinar)
- Multiobjective Variant of Tree-Seed Algorithm (Master Thesis: Gul Ozcan)
- Tree-Seed Algorithm for Automatic Programming (Master Thesis: Pervane Yunusova)

- Withering Process for TSA (Proceeding)
- TSA for Constrained Optimization
- Parallel TSA implemented on CUDA
- Improved versions of TSA for high dimensional function optimization
- More than 40 articles, proceedings, thesis

for your listening and contributions.