

A New Particle Swarm Optimization Technique

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Introduction

- Particle Swarm Optimization (PSO)
 - Invented by Eberhart & Kennedy in 1995
 - Motivated by social behavior of organisms
 - Learn from experience
 - Individual and group's past best

Introduction

- Particle Swarm Optimization

$$\Delta x_{id} = \Delta x_{id} + c_1 rand()(p_{id} - x_{id}) + c_2 rand()(p_{gd} - x_{id})$$

$$x_{id} = x_{id} + \Delta x_{id}$$

Introduction

- Particle Swarm Optimization
 - *c1 and c2 are parameters to be tuned*
 - rand() is random number between 0 and 1
 - the two rand() are independent
 - p_{id} and p_{gd} are individual best and group best
 - x_{id} is the position of each individual

Introduction

- Continuous PSO
- Discrete PSO
 - Flip each bit probabilistically
 - Research has been done on benchmark functions

New Particle Swarm Optimization

- Learn from experience
- From mistakes instead
- Individual and groups

New Particle Swarm Optimization

- Formulae are similar to PSO

$$\Delta x_{id} = \Delta x_{id} + c_1 rand()(p_{id} - x_{id}) + c_2 rand()(p_{gd} - x_{id})$$

$$x_{id} = x_{id} + \Delta x_{id}$$

- p_{id} and p_{gd} are individual worst and group worst

Comparison Functions

- Sphere function

$$f(x_i) = \sum_{i=1}^n x_i^2$$

- Griewank function

$$f(x_i) = \frac{1}{4000} \sum_{i=1}^n x_i^2 - \prod_{i=1}^n \cos \frac{x_i}{\sqrt{i}} + 1$$

Comparison Functions

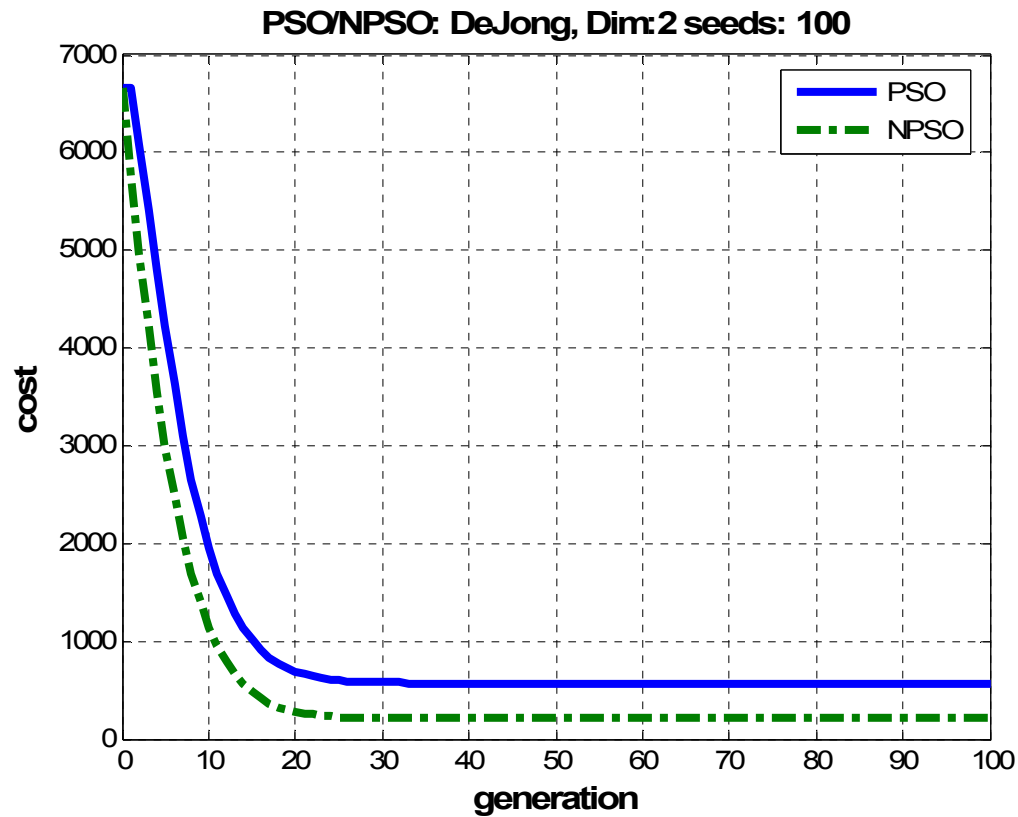
- Rastrigrin function

$$f(x_i) = \sum_{i=1}^n (x_i^2 - 10 \cos(2\pi x_i) + 10)$$

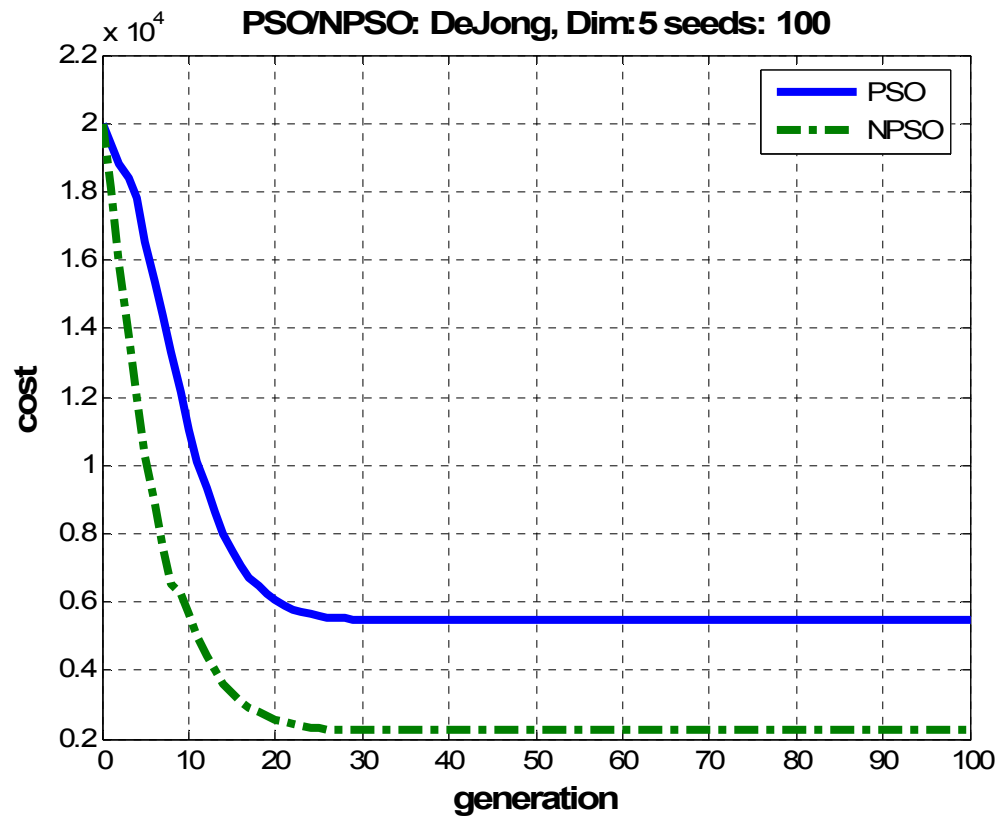
- Rosenbrock function

$$f(x_i) = \sum_{i=1}^n (100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2)$$

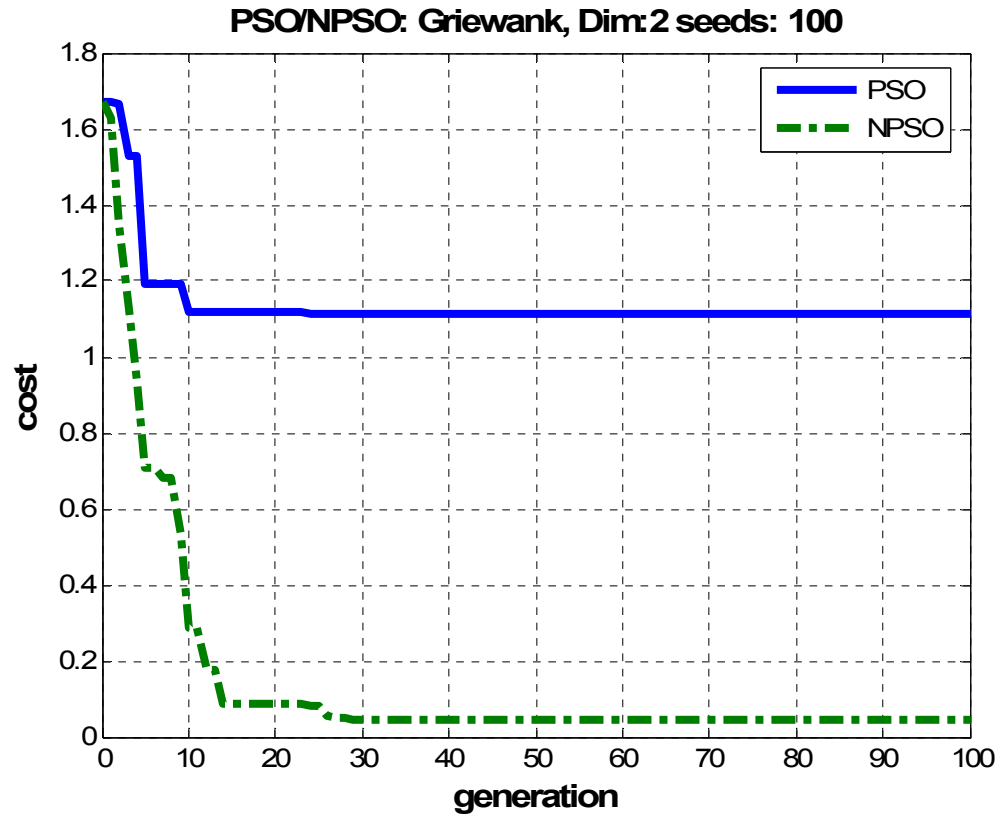
PSO vs. NPSO on Sphere



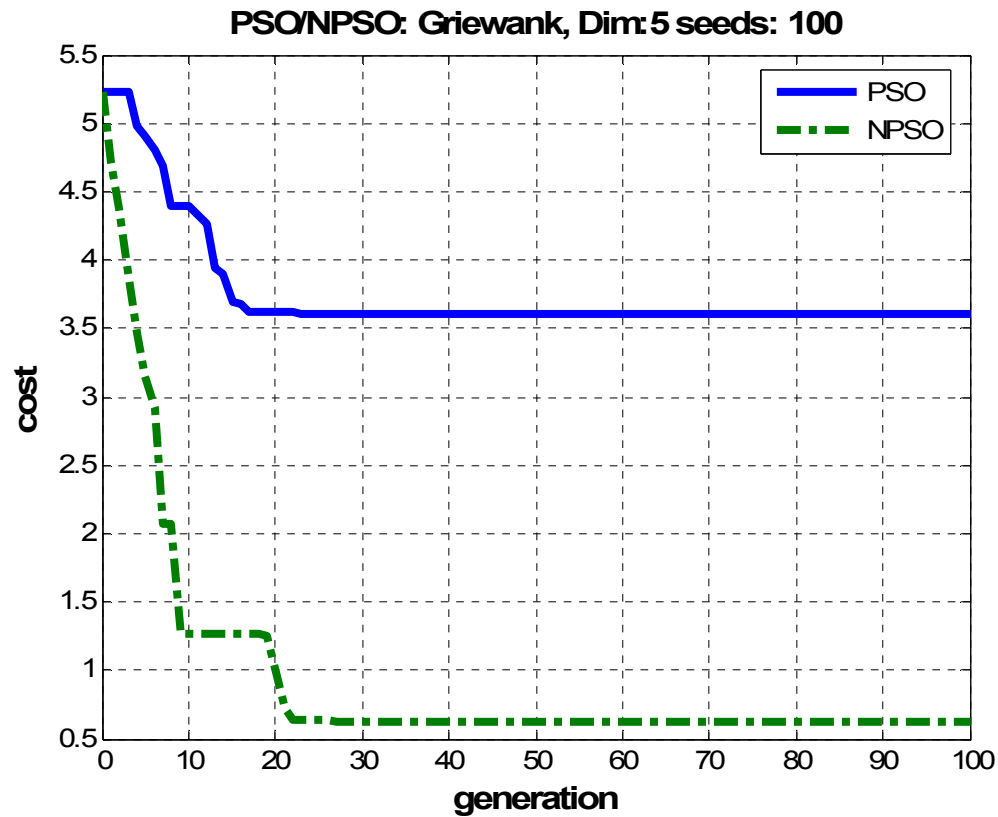
PSO vs. NPSO on Sphere



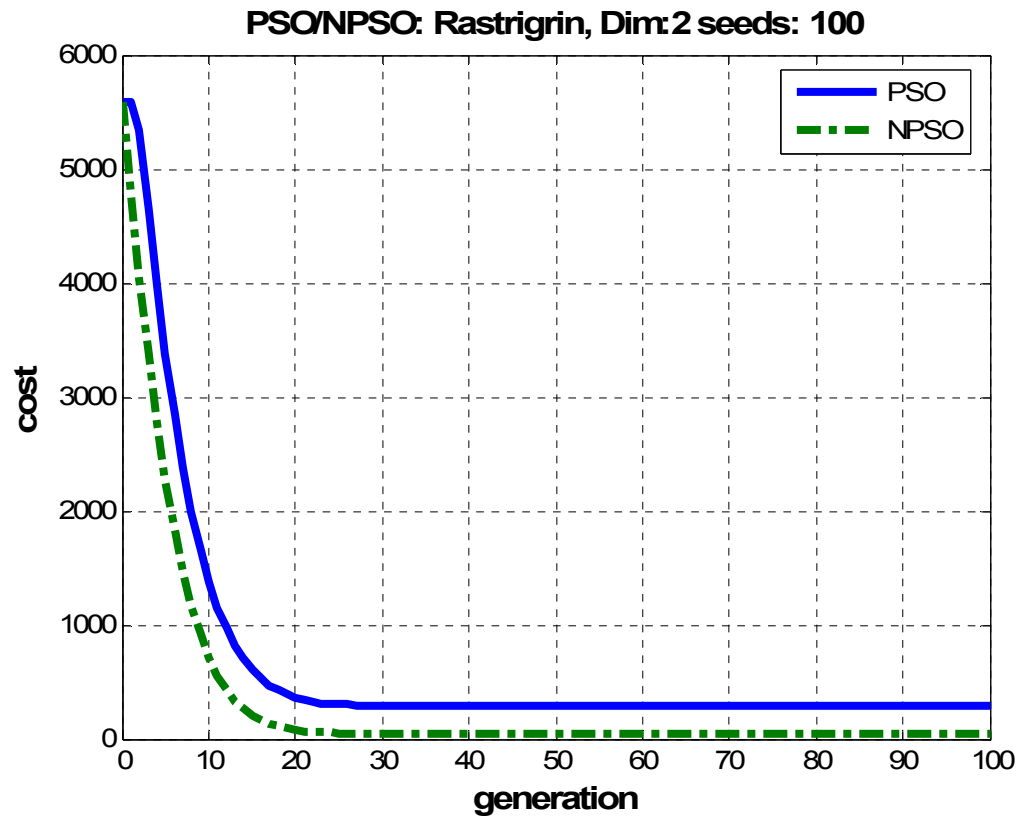
PSO vs. NPSO on Griewank



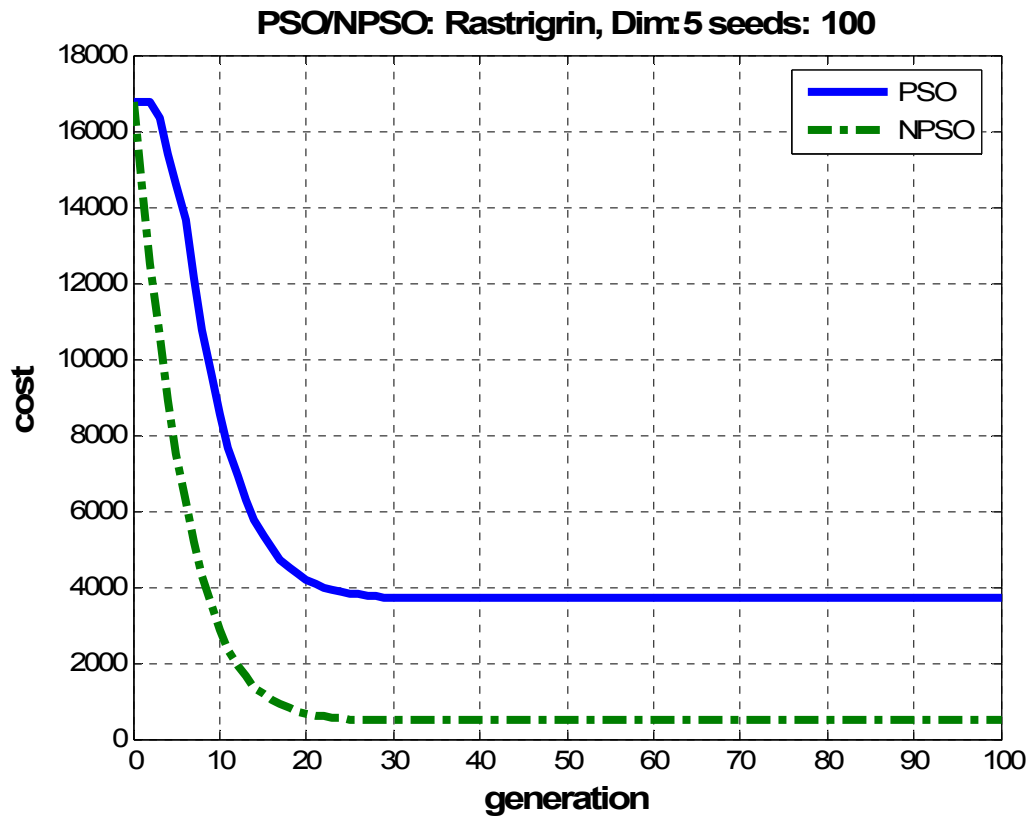
PSO vs. NPSO on Griewank



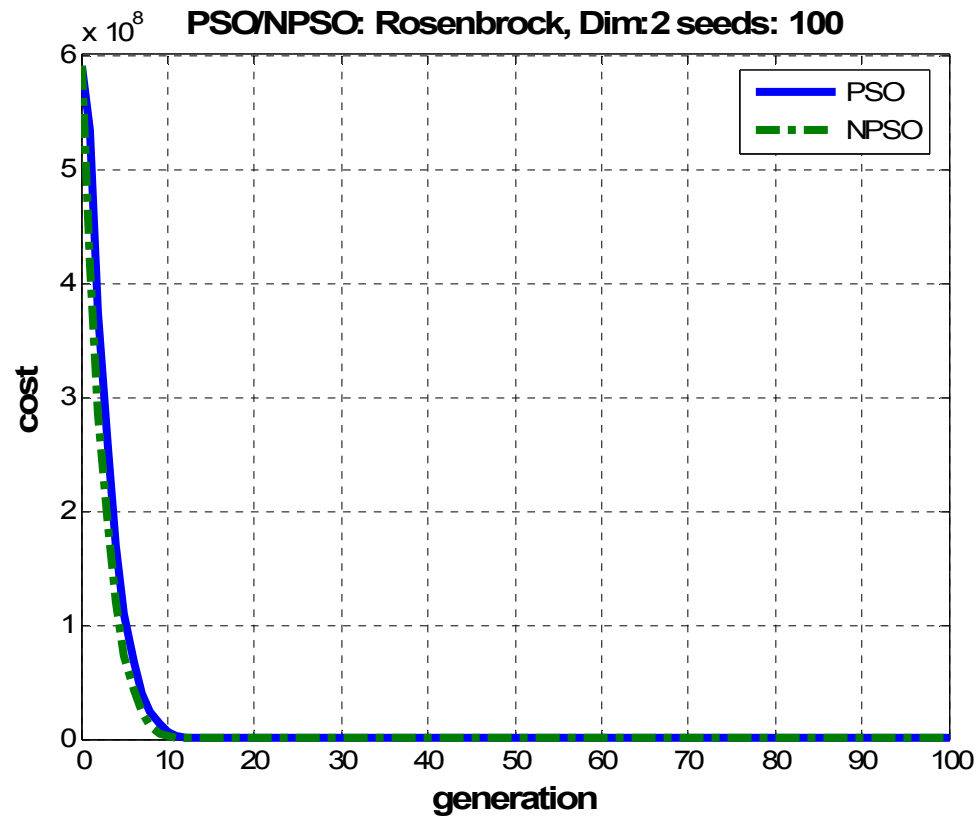
PSO vs. NPSO on Rastrigrin



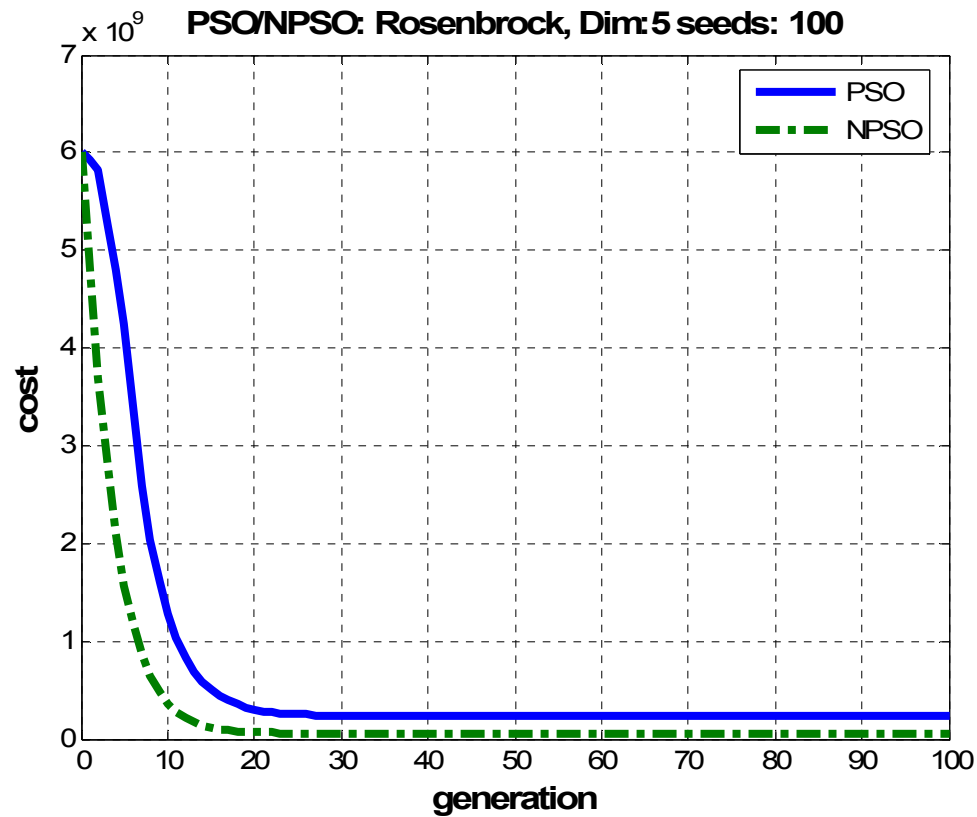
PSO vs. NPSO on Rastrigrin



PSO vs. NPSO on Rosenbrock



PSO vs. NPSO on Rosenbrock



Conclusion and Future Research

- NPSO finds better solutions than PSO in some cases
- Tests are based on very limited settings
- NPSO may not converge as fast as PSO
- The two may be combined
- Each particle may move conditionally