A Penalty Method Based-Spring Design Optimization Using Bio-inspired Computation Approach

Paper Id

AICAI2019_Paper_281

Authors

Chinwe Peace Igiri, Amity University Rajasthan, India

Prof. Deepshikha Bhargava, University of Petroleum and Energy Studies, Dehradun, India

Yudhveer Singh, Amity University Rajasthan, India

Presenting Author

Chinwe Peace Igiri

Outline


1
Background of study
2
Study Motivation
3
Review of Related Concept
4
Research Methodology
5
Performance Evaluation
6
Conclusion
7
Recommendations

Background of study

- **Optimization:** the selection of the best from the list of available options within a specified sets of constraints
- **Constraint Optimization:** Improving solution quality of objective function within the confinement of design variable values
- **Spring Design:** A typical benchmark function used to test algorithm performance
- **Bio-inspired Computation:** is a computational algorithm that models the behaviour of natural phenomena to solve complex problems.

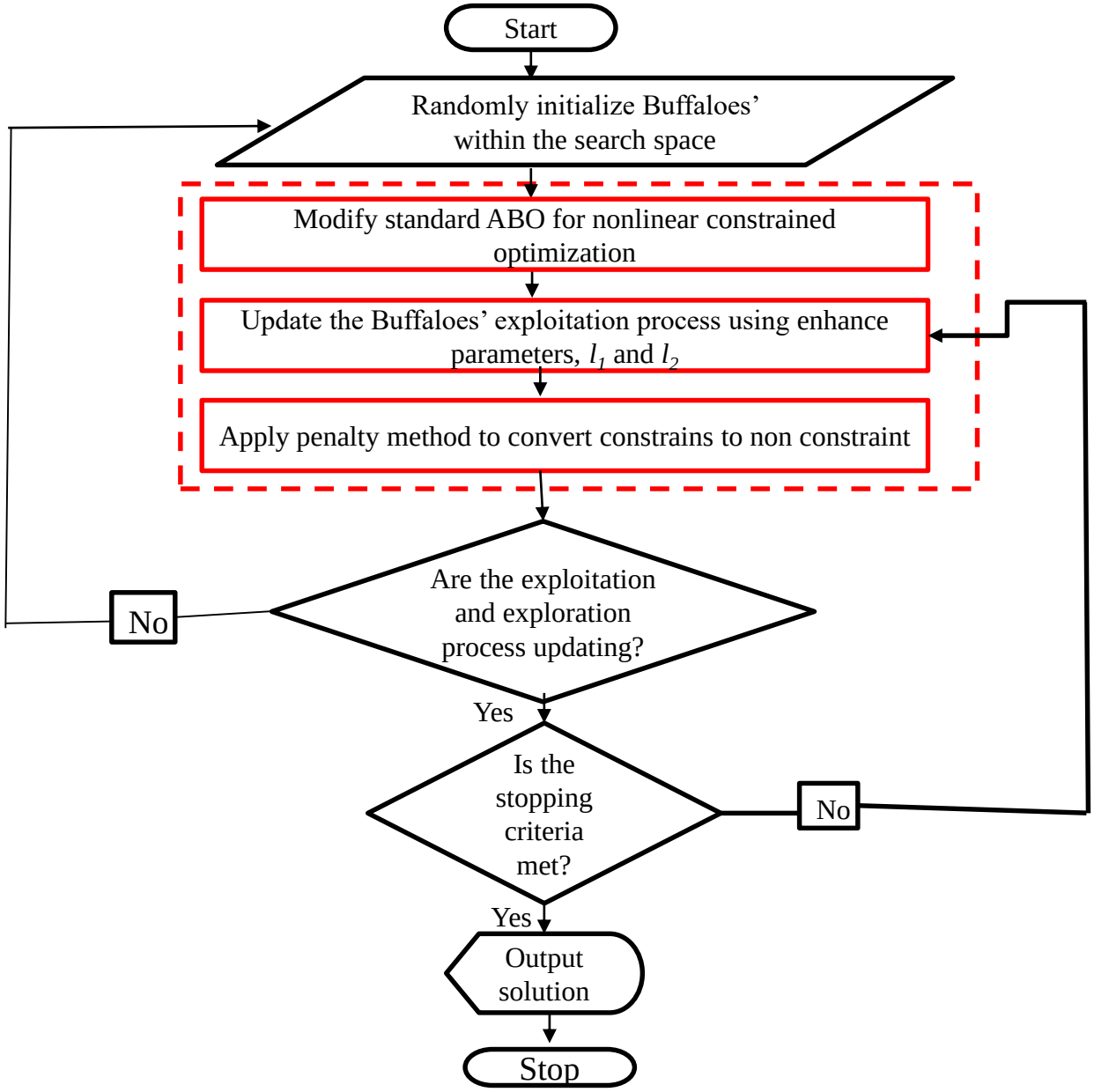
Study Motivation

- The need to overcome trial and error challenge in ensuring quality deliverable
- Modify standard African buffalo optimization algorithm for a nonlinear problem
- To identify the best bio-inspired algorithm for spring design optimization

Review of Related Concepts

Author (Year)	Study synopsis	Constrained Method	Result
He et al. (2004)	Improved PSO for engineering design optimization	Fly-back mechanism method	Outperformed other algorithms such as genetic adaptive search algorithm
Rajendra & Vijayarangan (2001)	Artificial genetic algorithm for leaf spring design	Violation parameter method	Reduce the leaf spring weight by 76.4 %
Yang (2014)	Fire fly and cuckoo search algorithm for spring design optimization	Penalty method	High quality solution with high computation
Hu et al. (2018)	Local search PSO for engineering design	Non-stationary multi-stage assignment penalty approach	Cost effective

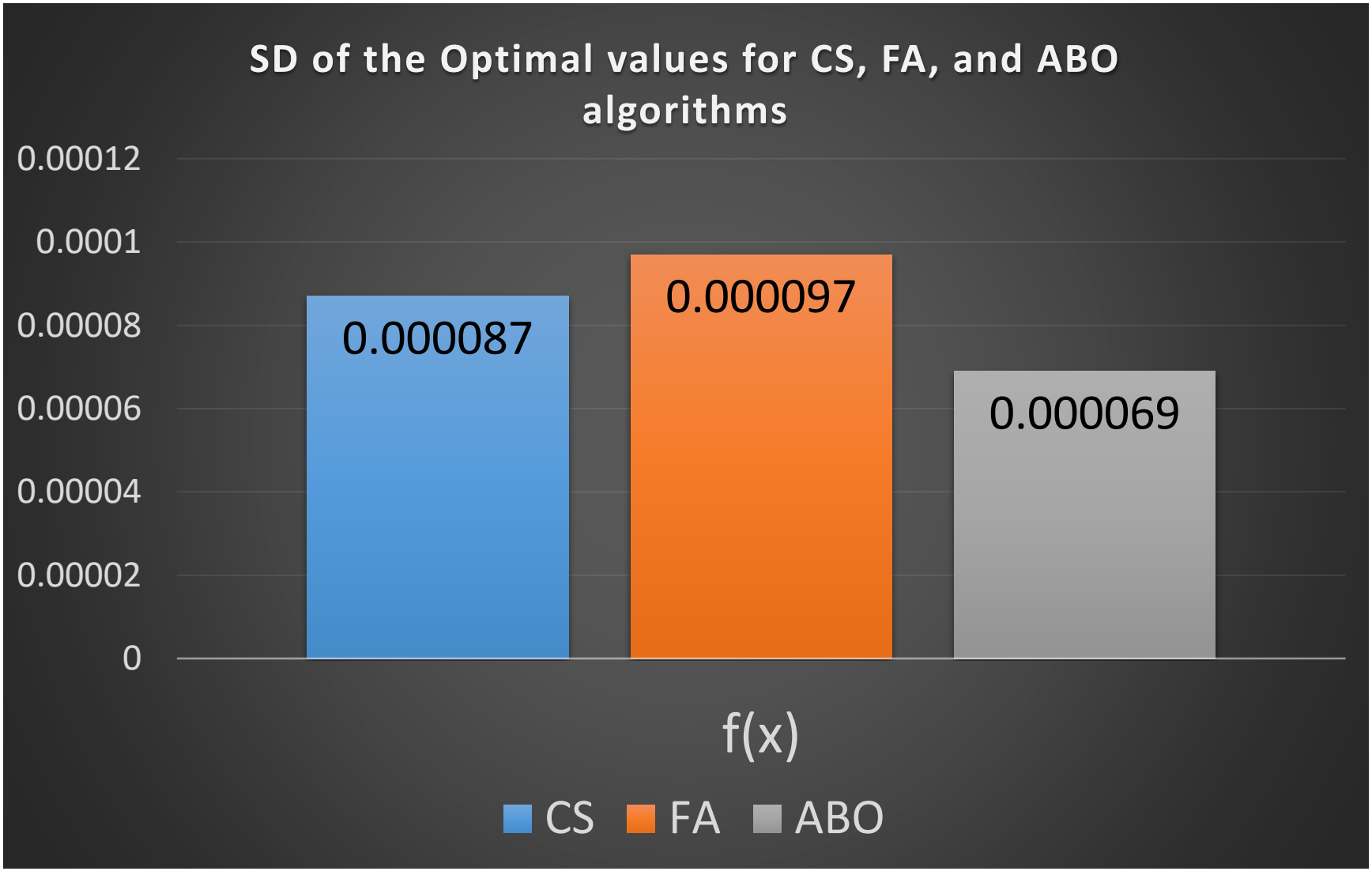
Research Methodology Flowchart



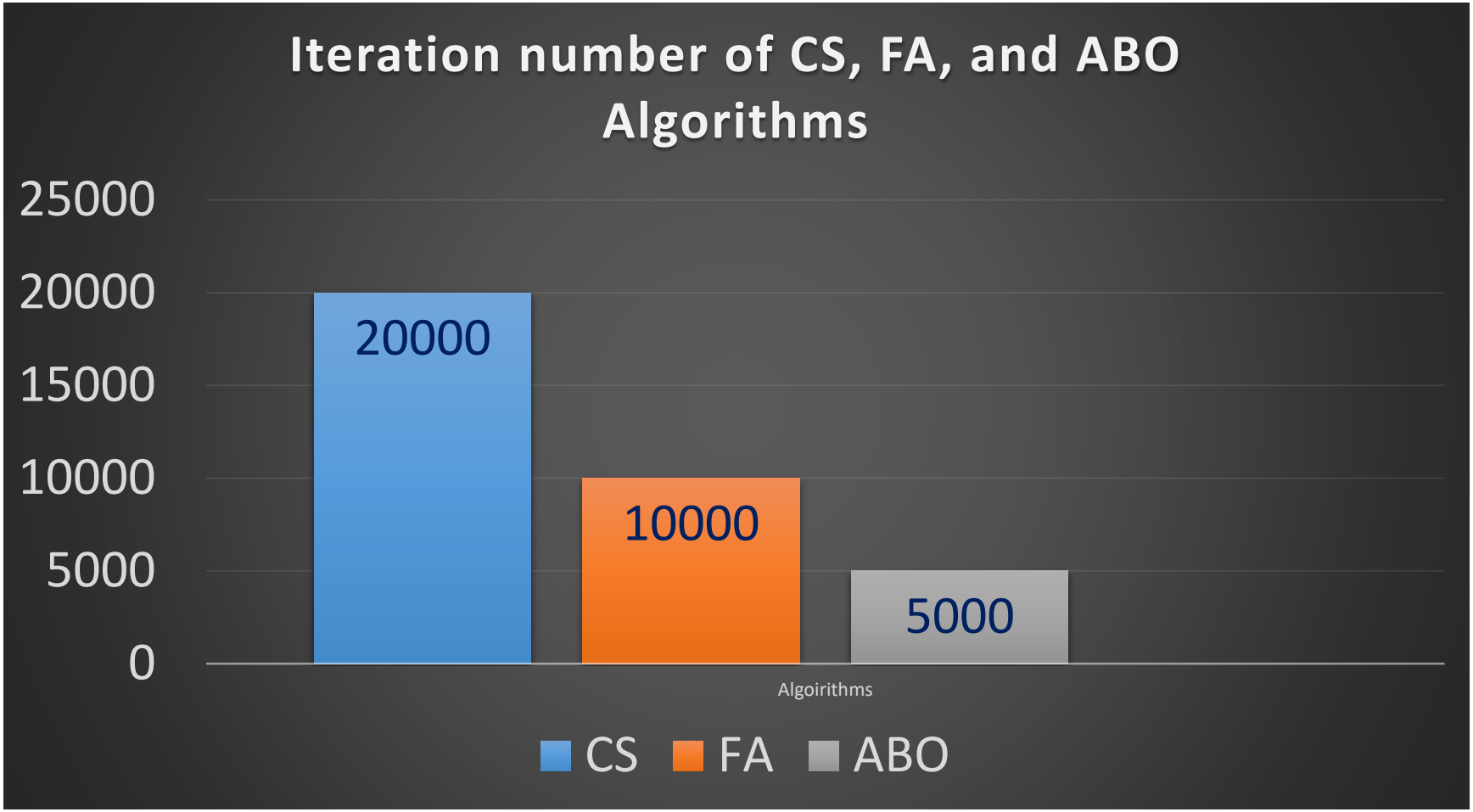
Performance Evaluation (Table)

	CS	FA	ABO	CS	FA	ABO
	Mean			SD		
f(x)	0.012742	**0.012731**	0.012803	0.000087	0.000097	**0.000069**
L_c	0.053226	0.052922	0.052176	0.001424	0.001524	0.001793
D_c	0.395669	0.388104	0.368654	0.036558	0.039072	0.043814
d	9.515569	9.89042	11.03994	1.572676	1.748004	2.313521
IT No	20000	10000	**5000**	20000	10000	**5000**

Performance Evaluation 2 (Graphical)



Performance Evaluation 3 (Graphical)



Conclusion

- Standard ABO has been improved for nonlinear constrained optimization problem

- The improve variant is compared with firefly algorithm (FA), cuckoo search (CS) using a standard engineering design benchmark problem (spring design)

- The improved variant more stable and cost effective than FA and CS

Recommendations

- The study could be extended to other engineering designs such as the welded beam, leaf spring, pressure vessel design, and many more.

- ABO could be hybridized with Bottle-nose Dolphin algorithm to optimize solution quality further.

QUERY

???