Title: Differential Evolution with Ensembles, Adaptations and Topologies

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Abstract: Differential Evolution (DE) is one of the most powerful stochastic real-parameter optimization algorithms of current interest. DE operates through similar computational steps as employed by a standard Evolutionary Algorithm (EA). However, unlike traditional EAs, the DE-variants perturb the current-generation population members with the scaled differences of distinct population members. Therefore, no separate probability distribution has to be used for generating the offspring. Since its inception in 1995, DE has drawn the attention of many researchers all over the world resulting in a lot of variants of the basic algorithm with improved performance. This tutorial will begin with a brief overview of the basic concepts related to numerical optimization and DE, DE's algorithmic components and control parameters. It will subsequently discuss some of the significant algorithmic variants of DE for bound constrained single-objective optimization. Recent modifications of the DE family of algorithms for constrained, multi-objective and niching problems will also be included. The talk will discuss the effects of incorporating ensemble learning in DE – a relatively recent concept that can be applied to swarm & evolutionary algorithms to solve various kinds of optimization problems. The talk will also discuss neighborhood topologies based DE and adaptive DEs to improve the performance of DE. The talk will finally highlight a few problems that pose challenge to the state-of-the-art DE algorithms and demand strong research effort from the DE-community in the future.

Bio-sketch: Bio-sketch: **Ponnuthurai Nagaratnam Suganthan** received the B.A degree, Postgraduate Certificate and M.A degree in Electrical and Information Engineering from the University of Cambridge, UK in 1990, 1992 and 1994, respectively. He received an honorary doctorate (i.e. Doctor Honoris Causa) in 2020 from University of Maribor, Slovenia. After completing his PhD research in 1995, he served as a pre-doctoral Research Assistant in the Dept of Electrical Engineering, the University of Sydney in 1995–96 and a lecturer in the Dept of Computer Science and Electrical Engineering, the University of Queensland in 1996–99. He was an Editorial Board Member of the Evolutionary Computation Journal, MIT Press (2013-2018) and an AE of IEEE Trans on Cybernetics (2012 - 2018), IEEE Trans on Evolutionary Computation (2005 - 2021). He is an associate editor of the Applied Soft Computing (Elsevier, 2018-), Neurocomputing (Elsevier, 2018-), IEEE Trans on SMC: Systems (2020 -), Engineering Applications of AI (Elsevier, 2022 -), Information Sciences (Elsevier, 2009 -), Pattern Recognition (Elsevier, 2001 -) and Int. J. of Swarm Intelligence Research (2009 -) Journals. He is a founding co-editor-in-chief of Swarm and Evolutionary Computation (2010 - 2023), an SCI Indexed Elsevier Journal. He is co-EiC of Computers and Electrical Engineering (2024 -) an Elsevier Journal. His co-authored SaDE paper (published in April 2009) won the "IEEE Trans. on Evolutionary Computation outstanding paper award" in 2012. His former PhD student, Dr Jane Jing Liang, won the

IEEE CIS Outstanding PhD dissertation award, in 2014. His research interests include randomization-based learning algorithms, swarm and evolutionary algorithms, pattern recognition, deep learning and applications of swarm, evolutionary & machine learning algorithms. He was selected as one of the highly cited researchers by Thomson Reuters yearly from 2015 to 2023 in computer science. He served as the General Chair of the IEEE SSCI 2013. He has been a member of the IEEE (S'90, M'92, SM'00, F'15) since 1991, Fellow since 2015, and an elected AdCom member of the IEEE Computational Intelligence Society (CIS) in 2014-2016. He was an IEEE CIS distinguished lecturer (DLP) in 2018-2021.