Differential Evolution Algorithms in High Resolution
CFD Applications

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Abstract

Genetic Algorithms (GA) fall within the large family of Evolutionary Algorithms (EA) and are valuable tools for optimization problems in engineering applications. In Genetic Algorithms, large populations containing genetic information (in our case, parameters for our optimization problem) interact in a reproductive process to pass on new genetic traits to subsequent generations [1]. One particular class of GA is Differential Evolution (DE) [2] where new generations have traits based on the difference in traits between randomly selected parents from the previous generation. The concept essential to the success of such methods is fitness, where some known function is employed to define the genetic quality of individuals. Previous application of GA to engineering problems employing Computational Fluid Dynamics (CFD) to obtain the fitness of individuals is prohibitively computationally expensive. Presented is a new form of DE combined with the Quiet Direct Simulation (QDS) method [3]. The QDS algorithm requires significantly less computational expense when compared to traditional Eulerian flows solvers, making it ideal for application within a GA optimization problem. Results are presented for various blast wave mitigation scenarios, demonstrating the applicability of the hybrid method.

References

