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Stochastic optimisation of GeantV code by use of genetic algorithms

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GeantV simulation is a complex system based on the interaction of different modules needed for detector simulation, which include transportation (heuristically managed mechanism of sets of predefined navigators), scheduling policies, physics models (cross-sections and reaction final states) and a geometrical modeler library with geometry algorithms. The GeantV project is recasting the simulation framework to get maximum benefit from SIMD/MIMD computational architecture and highly massive parallel systems. This involves finding the appropriate balance of several aspects influencing computational performance (floating-point performance, usage of off-chip memory bandwidth, specification of cache hierarchy, and etc.) and a large number of program parameters that have to be optimized to achieve the best speedup of simulation. This optimisation task can be treated as a "black-box"optimization problem, which requires searching the optimum set of parameters using only point-wise function evaluations. The goal of this study is to provide a mechanism for optimizing complex systems (high energy physics particle transport simulations) with the help of genetic algorithms and evolution strategies as a tuning process for massive coarse-grain parallel simulations. One of the described approaches is based on introduction of specific multivariate analysis operator that could be used in case of resource expensive or time consuming evaluations of fitness functions, in order to speed-up the convergence of the "black-box" optimization problem.

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