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Multi-Objective Optimization of Heat Load and Run Time for CEBAF Linacs Using Genetic Algorithms CODY REEVES, University of Florida, BALSA TERZIC, Old Dominion University, Thomas Jefferson National Accelerator Facility, ALICIA HOFLER, Thomas Jefferson National Accelerator Facility — The Continuous Electron Beam Accelerator Facility (CEBAF) consists of two linear accelerators (Linacs) connected by arcs. Within each Linac, there are 200 niobium cavities that use superconducting radio frequency (SRF) to accelerate electrons. The gradients for the cavities are selected to optimize two competing objectives: heat load (the energy required to cool the cavities) and trip rate (how often the beam turns off within an hour). This results in a multidimensional, multi-objective, nonlinear system of equations that is not readily solved by analytical methods. This study improved a genetic algorithm (GA), which applies the concept of natural selection. The primary focus was making this GA more efficient to allow for more cost-effective solutions in the same amount of computation time. Two methods used were constraining the maximum value of the objectives and also utilizing previously simulated solutions as the initial generation. A third method of interest involved refining the GA by combining the two objectives into a single weighted-sum objective, which collapses the set of optimal solutions into a single point. By combining these methods, the GA can be made 128 times as effective, reducing computation time from 30 min to 12 sec. This is crucial for when a cavity must be turned off, a new solution needs to be computed quickly.This work is of particular interest since it provides an efficient algorithm that can be easily adapted to any Linac facility.

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