

Genetic Algorithm Optimization of a Filament Winding Process Modeled in WITNESS

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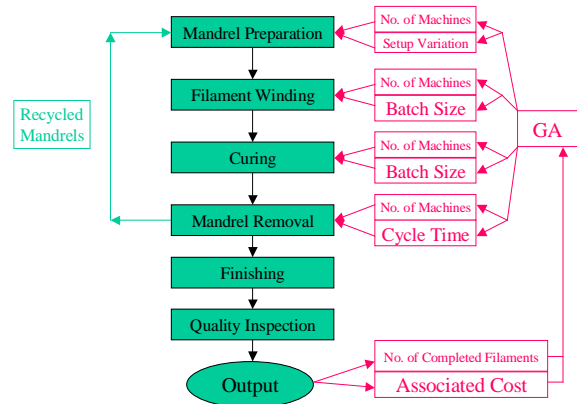
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Abstract

With the advent of smaller, less expensive, and generally more effective computers, simulation models and simulation environments have become increasingly popular tools for solving engineering problems. This paper describes an effort to link a genetic algorithm with WITNESS, a modeling program developed by AT&T and Istel, in order to optimize a model of a manufacturing process called filament winding.



1 FILAMENT WINDING MODEL

The filament winding process is an assembly process used by the advanced composites industry to make composite material filaments that are used in such products as rocket-motor cases, helicopter blades, piping, tubing, and drive shafts. For this research, a genetic algorithm is connected to a filament winding model (designed in WITNESS) in order to optimize it for a minimum setup cost per filament produced with the constraint that a minimum number of filaments need to be produced within a certain time limit. Figure 1 shows a schematic of the filament winding model, along with how the genetic algorithm interacts with the filament winding model.

2 RESULTS

For the purposes of this research, only two methods of determining the lowest cost per part are used. The first is the genetic algorithm, and the second is a random search. Both searches are allowed the same number of search points in their respective runs. Figure 2 shows how the genetic algorithm performs against the random search.

Figure 1: Filament Winding Model Schematic

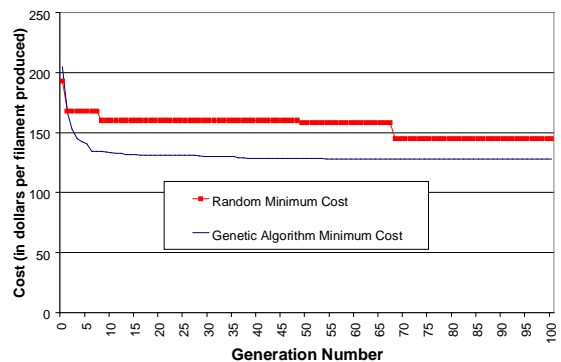


Figure 2: Minimum Cost, Both Optimization Methods

WITNESS itself has recently released its own optimization program for use. However, a comparison between the genetic algorithm and the WITNESS optimization package was not researched, mainly because the WITNESS optimization package is very expensive. Given its effectiveness, this genetic algorithm serves as a viable low-cost alternative for those WITNESS programmers looking to do optimization of their models.