

self-adaptative genetic algorithm for minimum thickness composite laminate design

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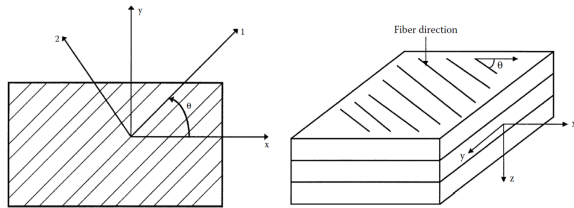


Fig. 1. Lamina

Abstract—In this study, a new variant of genetic algorithm(GA) is proposed to minimize thickness of composite laminate subject to in-plane loading. Tsai-wu Failure criteria is used to determine whether a laminate fails or not.

Keywords—Genetic Algorithm; Composite laminate; Classical laminate theory, Optimal design

I. INTRODUCTION

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II. METHODOLOGY

A. Selection

The purpose of the selection operator is how to choose parents to produce children of better fitness. Traditional methods of selecting strategies only take the fitness of the individual into account, however, because of the existence of constraint, the selection strategies have to change a little bit. The parents of next generation consists of three groups: proper groups, active groups, and potential groups.

Proper parents mean individual fulfills the constraint, which are chosen by the individual's fitness, individuals with better fitness are more likely to be chosen if they fit the constraint; active groups means that individual is supposed to be always exist in the parents during the GA, which are selected by fitness, ignoring the constraint; potential groups means that they are likely to turn into proper individual after a couple of generations, and potential individuals are chosen by constraint function, the more the individual fulfills the constraint, the more possibility it will be selected.

B. Crossover

The crossover operator happens among these three groups. The child of two proper groups are more likely to be a proper individual which can be used to obtain a better individual. The child of an active individual and a potential individual can significantly change the gene of active individual's chromosome, which lets the individual evolved toward a new direction. The offspring of two active individuals are more likely to be an active individual, which can maintain the active group.

C. Mutation

A mutation direction is imposed on the mutation operator which to make sure the individual evolving toward the right direction. The mutation direction, denoted by md , is a n dimensional vector corresponding to number of constraints, it is decided by the constraint thresholds CT_i and the current individual's constraint value, denoted as CV_i . The mutation vector can be obtained by the following formula

$$md = [CT_1, \dots, CT_{n-1}, CT_n] - [CV_1, \dots, CV_{n-1}, CV_n]$$

During the operator, the mutation consists of two parts, the length of the chromosome, and the angle of the chromosome. Because the chromosome's length is positive correlated with the individual's fitness, the coefficient of length mutation denoted by C_l , if $\sum_{i=1}^N CT_i$ great than zero, the mutation length is restricted to the range $[0, C_l \sum_{i=1}^N CT_i]$; if the $\sum_{i=1}^N CT_i$ less than zero, the mutation length is restricted to the range $[0, \sum_{i=1}^N CT_i]$; Assuming a $[136/-274]_s$ carbon T300/5308 composite laminate under the loading $N_{xx} = N_{yy} = 10$ MPa m, the only constraint is the safety factor greater than 1.

According to the Tsai-Wu criterion, its safety factor is 0.0539. So the mutation vector is $[0.941]$, assuming the coefficient is 20, so the mutation range is from 0 to 18. A random number is generated from the range $[0, 18]$, supposing the outcome is 13, then a length generator is used to a list, the it's sum is 13, suppose the list is $[5, 8]$, the laminate after mutation is $[13_{11} / -27_{12}]_s$.

The relationship between the angles in the composite laminate and the chromosome's fitness is unclear, so the mutation direction of chromosome's angle is random. The coefficient angle mutation is C_a , $[0, C_a \sum_{i=1}^N CT_i]$

III. CONCLUSION

The conclusion goes here.

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REFERENCES

- [1] H. Kopka and P. W. Daly, *A Guide to L^AT_EX*, 3rd ed. Harlow, England: Addison-Wesley, 1999.