Using Finite Elements for the Classification of Aircraft Finishing Materials

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Abstract— The finite element method has been generally used to approximate solu tions to differential equations describing physical phenomena. Using finite elements for classification purposes required a type of neural network to be developed. In this case there would be no differential equation to be solved. The goal of the neural network is to accept a set of descriptive parameters of an object as inputs and return the classification of the object described. In this case the object would be the aircraft finishing materials and they would be classified as good or bad.

The greater the number of descriptive parameters used the more accurate a classification of an object would be. In this case the number of descriptive parameters would be equivalent to the number of dimensions used in the finite element analysis. With this in mind we considered using finite elements in four and higher dimensions, which allows the use of four or more descriptive parameters. Finite elements have been commonly used up to three dimensions.

The basic steps for the finite element method are: 1)the discretization of the domain into a collection of subdomains, called finite elements, 2) over each subdomain a solution approximated by functions of desired type (in this case linear functions), and algebraic equations relating the nodal values (pre-selected points called nodes which define the subdomains) are defined, and 3) the finite element equations are assembled using the continuity of the nodal values. With this procedure a solution to the whole domain is approximated. Since we concentrated in using linear approximations the subdomains were triangles. Triangulation was used for any domain, for example two dimensions each element was a triangle of three nodes, for three dimensions we had quadrilaterals of four nodes, and so on. In order to concentrate in writing the finite element algorithm I had to find tools that I could use for my program, such tools included a grid or mesh generator. Dr. Meade, a professor in the mechanical engineering department at Rice University, advised me to get familiar with a program called Qhull. Qhull is a general dimension convex hull and Delaunay triangulation computations program; it implements the quick hull algorithm for computing a convex hull. The geometry center has created a homepage for Qhull the address is: http://www.geom.umn.edu/software/qhull/. I was able to use Qhull as the grid generator for the finite element algorithm.

We have achieve success in the two and three parameters finite element approximations, I am presently working on the algorithm for four dimensions.