

Thermal Buckling Analysis of Composite Plates using Isogeometric Analysis based on Bezier Extraction

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Data transmission back and forth between finite element analysis (FEA) and computer-aided design (CAD) is a matter of huge concern today [2] and Isogeometric analysis [1] has been successful in merging these two fields in the recent past. The presentation will address isogeometric finite element approach (IGA) in combination with the first-order deformation plate theory (FSDT) for thermal buckling analysis of laminated composite plates. The IGA utilizes non-uniform rational B-spline (NURBS) as basis functions, resulting in both exact geometric representation and high order approximations [3] [4]. It enables to achieve easily the smoothness with arbitrary continuous order. The analyses have been performed using Bezier extraction and conventional IGA. In conventional isogeometric analysis the basis functions are not confined to one single element, but span a global domain whereas the Bézier extraction operator decomposes a set of linear combinations of Bernstein polynomials. The presentation will give a theoretical overview of B-splines, as well as NURBS, and also the concept of Bézier decomposition of these spline functions. The focus will then be on how the use of Bézier extraction eased the implementation into an already existing finite element code. This theoretical background will then be used to explain an isogeometric finite element analysis program.

With the advent of More Electric Aircrafts [5], solving thermal structural problems [6] are of utmost importance in the aerospace industry. A static thermal structural validation problem will be presented for both constant and linear thermal temperature variation along the thickness. The presentation will then explain the procedures implemented for stress recovery and computing the geometric stiffness matrix. Numerical results of circular and elliptical plates will be provided to validate the effectiveness of the proposed method as compared to traditional FEA. The final section of the presentation proposes to detail the influences of length to thickness ratio, aspect ratio, boundary conditions, stacking sequence and material property on the critical buckling temperature. A special section would cover the idea of third order deformation theory for thicker plates and the effect of degree of NURBS basis on the results.

Bibliography

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