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Efficient Modelling for the Shape Optimisation of Shells and Stiffened Structures

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Structural optimisation requires a suitable mix of an accurate geometric description and an efficient analysis model. Isogeometric Analysis (IGA) fills this need, as it reconciles computer-aided design (CAD) with structural analysis by using spline functions as finite element bases. Since CAD uses the boundary representation (B-rep), IGA is especially suitable for analysing structures whose geometry is easily derived from a surface, as is the case for shells. Therefore, the efficiency of IGA-based shape optimisation of shells has been observed [1-2] and capable algorithms have been proposed. However, its applicability to complex structures as skin stiffened aerostructures is not yet proven. Non-conforming interface [3] between the stiffeners and the skin is needed in order to get an attractive design space. The simplicity and the efficiency of the coupling depends on the chosen shell formulation. We explore and compare the use of two formulations: the Kirchhoff-Love formulation for thin shells and a solid-shell model for thicker shells. Starting from numerical examples involving simple stiffened panels, the final goal is to propose a general framework for optimising the buckling behaviour of large and complex aeronautical structures.

REFERENCES

[1] J. Kiendl, R. Schmidt, R. Wüchner and K.-U. Bletzinger, Isogeometric shape optimization of shells using semi-analytical sensitivity analysis and sensitivity weighting, *Comput. Methods Appl. Mech. Eng.*, Vol. **274**, pp. 148–167, 2014.

[2] A.P. Nagy, S.T. Ijsselmuiden and M.M. Abdalla, Isogeometric design of anisotropic shells: Optimal form and material distribution, *Comput. Methods Appl. Mech. Eng.*, Vol. **264**, pp. 145–162, 2013.

[3] R. Bouclier, J.-C. Passieur and M. Salaün, Local enrichment of NURBS patches using a non-intrusive coupling strategy: Geometric details, local refinement, inclusion, fracture, *Comput. Methods Appl. Mech. Eng.*, Vol. **300**, pp. 1–26, 2016.