POST-BUCKLING MODAL INTERACTION IN DYNAMICALLY LOADED COMPOSITE CURVED PANELS

Eelco Jansen[1]*, Tanvir Rahman[2] and Raimund Rolfes[3]

[1]Leibniz Universität Hannover, Appelstr. 9A, 30167 Hannover, Germany,
e.jansen@isd.uni-hannover.de

[2]DIANA FEA BV, Delftechpark 19a, 2628 XJ Delft, The Netherlands, t.rahman@dianafea.com

[3]Leibniz Universität Hannover, Appelstr. 9A, 30167 Hannover, Germany,
r.rolfes@isd.uni-hannover.de

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The buckling and post-buckling behaviour of composite panels is an important topic in the design of aircraft structures. Post-buckled design is of particular interest for fuselage panels. Investigations including dynamic (i.e. inertial and damping) effects in the structural analysis of aircraft have been carried out in recent years in the context of the EU FP7 project DAEDALOS.[1] Consideration of the actual, dynamic loads that are acting on the aircraft gives the possibility to improve the physical and numerical modelling of the failure behaviour of the structure. In the present contribution, the modal interactions that occur in the post-buckling behaviour of curved panels under dynamic in-plane loading are investigated.

A perturbation approach has been used in earlier studies as the basis of a reduction method for the finite element buckling and post-buckling analysis of panel-type structures under static loading. It was shown that the complicated post-buckling behavior of large stiffened panels can in the static case be satisfactorily described by a multi-mode reduced order approach. Perturbation-type approaches can also constitute the basis of a nonlinear reduced order dynamic analysis.[2,3] In work of the present authors it was demonstrated, that the nonlinear response of flat composite plates under dynamic loading can be captured at load levels, comparable to the static buckling load level.[2]

In the present work, the multi-mode reduced order formulation will be used to describe the modal interactions in the nonlinear behaviour of curved composite panels under dynamic loading. Both the effect of the dynamic fundamental state response and the participation of several interacting buckling modes are studied for representative curved panel configurations.

REFERENCES

[1] C. Bisagni. Overview of the DAEDALOS project. Progress in Aerospace Sciences, Vol. 78, 1–7, 2015.

[2] E.L. Jansen, T. Rahman, R. Rolfes, Reduced Order Models for Static and Dynamic Analysis of Composite Panels Based on a Perturbation Approach, *Applied Mechanics and Materials*, Vol. 828, 199-212, 2016.

[3] H. Chen and L.N. Virgin. Finite element analysis of post-buckling dynamics in plates - Part I: An asymptotic approach. International Journal of Solids and Structures, Vol. 43, 3983–4007, 2006.