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Editorial Open Access

Damping as Means of Structural Integrity Assessment in Aircraft Industry

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Editorial

As presented in [1] damping plays an important role in technical practice, while according to [2] it is important for many load types. For each material there are many mechanisms [2] generating damping.

As also explained in [1], structural defects (i.e. pores, cracks) according to [3] introduce local flexibilities affecting the vibration responses and leading to coupled systems, with new harmonics in the spectrum. Damping plays a very important role as a material and structure property when dealing with vibrating structures from the point of view of vibration isolation or even crack arrest in many applications: bearings, filters, aircraft parts, and generally structures made out of porous materials or facing crack development and propagation.

From all damping mechanisms thermodynamic damping has been shown to be an important alternative in structural integrity assessment through dynamic evaluation of defective structures.

The thermodynamic theory of damping was used in [4,5] to find material and system damping due to change in material porosity or crack depth in a homogeneous, isotropic, elastic bar with either uniformly distributed ellipsoidal cavities under alternating uniform axial stress or propagating fracture respectively. In these works it was shown that thermodynamic damping accounts only for the structural defect and can be used as a measure of change in material porosity or as indicator of crack severity.

Conclusion

Up to now a rigid thermodynamic damping theory accompanied by analytical and experimental tools for calculation and measurement of damping are available. Series of thermodynamic damping applications, analytical and experimental, have been presented in literature exploring the effect of porosity and cracks on damping of defective structures.

The evaluation of the very promising damping results in comparison to data acquired with conventional methods for structural integrity assessment, as well as the accumulated experience on analytical and experimental investigations, lead as a next research step to the use of damping as an alternative means of aircraft structural integrity identification and monitoring.

In the frame of the developed technique the analytical work was restricted on structures of ideal shapes. However, given that damping is a material and system property, structures of any shape may be modeled accordingly in order to be tested. Hence, aircraft holistic modeling, in combination to design and development of suitable measuring system, would lead to accurate and competitive means for aircraft structural assessment. Such a research approach would bring up unanswered theoretical issues, which need to be solved.

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