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OPTIMAL LOCATION OF PIEZOELECTRIC SENSORS AND ACTUATORS FOR NOISE REDUCTION IN SANDWICH PANELS

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Abstract: Noise reduction is a fundamental issue for the competitiveness in the transportation industry. Structures should be optimized for cost, weight, vibration and noise attenuation, subject to technological, failure and stress constraints. The generalized introduction of lightweight composites in the automotive and aerospace industries, while leading to significant weight reductions and associated fuel savings, pose a serious problem of low acoustic performance of these lightweight composites when subjected to mechanical or acoustic excitations. Passive damping technologies are nowadays frequently used to control sound and vibration levels through the use of viscoelastic materials, while active devices such as surface bonded piezoelectric patches can also be effectively used to control these undesired sound and vibration levels in lightweight composite structures. Sandwich composite panels may represent an optimized solution for both sound radiation and structural vibration for most frequency ranges. Viscoelastic materials are an efficient way of reducing structural vibrations and providing noise attenuation, which allied to active elements may lead to broader control capabilities regarding acoustic emissions. This paper addresses the issue of noise reduction in laminated sandwich plates using both passive and active elements. A finite element implementation of a laminated sandwich plate element with viscoelastic core and surface bonded piezoelectric patches is used to obtain the frequency response of the panels. The sound transmission characteristics of the panels are evaluated by computing their radiated sound power and radiation efficiency, using the Rayleigh integral method. The optimal location of the surface co-located pairs of piezoelectric patches is then obtained to minimize both weight and noise radiation. A recent methodology of optimization, based on direct search techniques, was used: Direct MultiSearch (DMS) optimization. This methodology does not use derivatives and does not aggregate any of the problem objective functions. Trade-off Pareto optimal fronts and the respective optimal active patch configurations are obtained and the results will presented, analyzed and discussed.