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QUASI-TRIVIAL SOLUTIONS FOR UNCOUPLED, HOMOGENEOUS AND QUASI-HOMOGENEOUS LAMINATES WITH HIGH NUMBER OF PLIES

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Quasi-trivial (QT) sequences are a class of lamination sequences for which, in the framework of Classical Laminate Theory (CLT), the properties of uncoupling and/or homogeneity are verified in a closed-form solution [1]. QT stacking sequences have received great attention from the scientific community since, in many instances, they have proved to be an extremely powerful tool for the design and optimization of composite laminates.

Nevertheless, their use remains limited due to two main reasons: first, to find QT stacking sequences, a proper and complex algorithm is required; second, calculations become computationally intensive for long QT sequences and limit the maximum number of plies attainable. This second aspect limits the use of QT solutions only for applications involving thin laminates.

In order to exploit QT stacks for thick laminates and thus contribute to a larger diffusion of this class of laminates, new tools are developed. Firstly, a new and more efficient algorithm for finding QT stacking sequences is developed and an original procedure is devised to effectively code it. Thanks to this new algorithm a database containing QT sequences with a large number of plies can be created. Moreover, for a given number of plies, the proposed algorithm finds a greater number of QT solutions, with respect to those given in [1]. In a second time, analytical relationships are derived to obtain QT sequences by superposition of known QT sub-sequences. Thanks to this new class of closed-form solutions, laminates can be designed using QT stacking sequences without limitations on the maximum number of plies.

The results presented in this work open new possibilities for the design and optimization of thick laminates. In addition, laminates with special requirements may be designed by superposition of QT stacks, thus reaching specific design goals that cannot otherwise be met.

REFERENCES

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