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Harmonic differential quadrature method and applications to analysis of structural components. (English) Zbl 0854.73080

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Summary: A harmonic differential quadrature (HDQ) method with application to the analysis of buckling and free vibration of beams and rectangular plates is presented. A new approach is proposed for the determination of the weighting coefficients for differential quadrature. It is found that the HDQ method is more efficient than the ordinary differential quadrature (DQ) method, especially for higher order frequencies and for buckling loads of rectangular plates under a wide range of aspect ratios. Also, some shortcomings existing in the DQ method are removed.

MSC:

74S30 Other numerical methods in solid mechanics (MSC2010)
74G60 Bifurcation and buckling
74H45 Vibrations in dynamical problems in solid mechanics
65D32 Numerical quadrature and cubature formulas

Keywords:

beams; rectangular plates; weighting coefficients

Full Text: DOI

References:

[1] Bellman, R. E., Casti, J.: Differential quadrature and long-term integration. J. Math. Anal. Appl.34, 235-238 (1971). · Zbl 0236.65020 · doi:10.1016/0022-247X(71)90110-7

[2] Civan, F., Sliepcevich, C. M.: Differential quadrature for multi-dimensional problems. J. Math. Anal.101, 423-443 (1984). · Zbl 0557.65084 · doi:10.1016/0022-247X(84)90111-2

[3] Bellman, R. E., Kashef, B. G., Casti, J.: Differential quadrature: a technique for the rapid solution of non-linear partial differential equations. J. Comp. Phys.10, 40-52 (1972). · Zbl 0247.65061 · doi:10.1016/0021-9991(72)90089-7

[4] Bert, C. W., Jang, S. K., Striz, A. G.: Two new approximate methods for analyzing free vibration of structural components. AIAA J.26, 612-618 (1988). · Zbl 0661.73063 · doi:10.2514/3.9941

[5] Bert, C. W., Striz, A. G., Jang, S. K.: Nonlinear deflection of rectangular plates by differential quadrature. In: Proc. Int. Conf. Comput. Engng. Sci., Vol. I, Chap. 23, pp. iii.1?iii.4, Atlanta, Georgia 1988. · Zbl 0695.73029

[6] Bert, C. W., Jang, S. K., Striz, A. G.: Nonlinear bending analysis of orthotropic rectangular plates by the method of differential quadrature. Comp. Mech.5, 217-226 (1989). · Zbl 0695.73029 · doi:10.1007/BF01046487

[7] Striz, A. G., Jang, S. K., Bert, C. W.: Nonlinear bending analysis of thin circular plates by differential quadrature. Thin-Walled Struct.6, 51-62 (1988). · doi:10.1016/0263-8231(88)90025-0

[8] Jang, S. K., Bert, C. W., Striz, A. G.: Application of differential quadrature to static analysis of structural components. Int. J. Num. Methods Eng.28, 561-577 (1989). · Zbl 0669.73064 · doi:10.1002/nme.1620280306

[9] Sherbourne, A. N., Pandey, M. D.: Differential quadrature method in the buckling analysis of beams and composite plates. Comput. Struct.40, 903-913 (1991). · Zbl 0850.73355 · doi:10.1016/0045-7949(91)90320-L

[10] Wang, X., Bert, C. W.: A new approach in applying differential quadrature to static and free vibrational analyses of beams and plates. J. Sound Vib.162, 566-572 (1993). · Zbl 0958.74527 · doi:10.1006/jsvi.1993.1143

[11] Wang, X., Bert, C. W., Striz, A. G.: Differential quadrature analysis of deflection, buckling, and free vibration of beams and rectangular plates. Comput. Struct.48, 473-479 (1993). · doi:10.1016/0045-7949(93)90324-7

[12] Bert, C. W., Wang, X., Striz, A. G.: Static and free vibrational analysis of beams and plates by differential quadrature method. Acta Mech.102, 11-24 (1994). · Zbl 0810.73077 · doi:10.1007/BF01178514

[13] Leissa, A. W.: The free vibration of rectangular plates. J. Sound Vib.31, 257-293 (1973). · Zbl 0268.73033 · doi:10.1016/S0022-460X(73)80371-2

[14] Iyengar, N. G. R.: Structural stability of columns and plates. Chicester: Ellis Horwood 1988.

[15] Timoshenko, S. P., Gere, J. M.: Theory of elastic stability, 2nd ed. New York: McGraw-Hill 1961.