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Indirect radial basis function approach for bending, free vibration and buckling analyses of functionally graded microbeams

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Abstract

The main aim of this paper is to provide a simple yet accurate solution approach for bending, free vibration and buckling analyses of functionally graded (FG) Euler-Bernoulli and Timoshenko microbeams based on the strain gradient theory (SGT). The non-classical microbeam model incorporates the material length scale parameter which can consequently capture the size effect. The adopted model also can degenerate to the beam model based on the modified couple stress theory (MCST) or the classical beam theory (CBT) by setting two or all material length scale parameters to be zero. The material properties of the beam are assumed to vary continuously with respect to the thickness direction according to the Mori-Tanaka homogenization technique. By using Hamilton's principle, the governing equations of motion and corresponding boundary condition equations are derived. Then indirect radial basis function approach is applied along axial direction to discretize the highest derivatives appearing in the system of equations. Effects of the number of collocation points and shape parameter on the accuracy of present solutions are investigated and convergence studies are shown that the approach is sensitive to these two parameters. Some of results are compared with the previously published solutions to validate accuracy and reliability of the present approach.

Keywords: Indirect radial basis function; Microbeam; Strain gradient theory; Functionally graded.

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