Exact PDE close-form solution of the vibrating rectangular nanoplates using nonlocal trigonometric shear deformation plate theory

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In this study, exact close form solution for free flexural vibration of rectangular nanoplates presented based on nonlocal trigonometric shear deformation theory, with neglect in-plane displacements of the mid-plane to calculate the local and nonlocal natural frequency. As well nonlocal elasticity theory is employed to investigate effect of small scale on natural frequency of the plate. The novelty of the paper is that the analytical closed-form solution is developed without any use of approximation for a combination of six different boundary conditions; specifically, two opposite edges are hard simply supported and any of the other two edges can be hard simply supported, clamped or free. Governing equations of motion of the plate are derived by using the Hamilton's principle. The present analytical solution can be obtained with any required accuracy and can be used as benchmark. Numerical examples are presented to illustrate the effectiveness of the proposed method compared to other methods reported in the literature. Finally, the effect of boundary conditions, variations of aspect ratios, thickness ratios and small scale parameter on natural frequency parameters and vibration mode sequence are examined and discussed in detail.