Improved algorithms applying the numerical Laplace method for response analyses of Timoshenko beam subjected to typical external loads

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Highlights

- This paper develop the derivations of Su and Ma's theory in stationary load case by considering the non-proportional damping condition and a variety of boundary conditions, and thus it has strong application prospect.
- Based on the fundamental solution of stationary load case, a FEM technology is exploited for moving load case and the numerical solution is derived. Because the stationary load case and the moving load case are the essential excitations on beam surface, more complicated load cases can be composed of them.
- A 'Fast FEM Transformation' is proposed for moving load case by uniform division strategy along the beam to improve the algorithm efficiency.
- To verify the damping cases of the numerical solutions, a special proportional damping condition is conducted for normal mode superposition approach.
- Non-proportional damping influences are evaluated through parameter studies by means of numerical method, where consistent piecewise-linear laws are observed.