

Paradoxical Behaviour of Vibrating Systems Challenging Rayleigh's Theorem

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Rayleigh has proved a theorem that an additional constraint cannot reduce any of the natural frequencies of an elastic conservative vibration system. Since linear free vibration and linear stability problems are analogous to each other mathematically, the question arises, whether there exist a counterexample to Rayleigh's theorem, because to a similar theorem on critical loads, there are counterexamples. In this paper, examples of vibrating systems will be shown that contradict Rayleigh's theorem. So the known form of Rayleigh's theorem might need correction. From the results presented here it follows that Rayleigh's theorem is valid if additional restraints have no effect on pre-vibration displacements, or there are no pre-vibration displacements, but additional restraints on pre-vibration displacements can decrease the natural frequencies. The latter case can happen if external static forces are in the system.

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