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Frequency Response of Nonproportionally Damped, Lumped Parameter, Linear Dynamic Systems

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Title:	FREQUENCY RESPONSE OF NONPROPORTIONALLY DAMPED, LUMPED PARAMETER, LINEAR DYNAMIC SYSTEMS
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Abstract:	<p>The frequency response of nonproportionally (or nonclassically or non-Rayleigh) damped linear lumped mass systems is discussed here. The exact method, via Laplace transforms, is presented and the practical difficulties revealing the necessity of approximate methods are emphasized. Modal analysis is used to transform the governing equations of motion to the respective modal coupled equations of motion. The Laplace transform is performed to transfer to the frequency domain. The modal coupling is then analyzed through coupling terms. A criterion in the form of nonproportionality indices is developed, in order to measure the extent of the modal coupling and to predict the error introduced by neglecting this coupling either partially or completely. An attempt to interpret the frequency spectrum of the modal coupling is also made. A specific application to a six degree of freedom system, with two sets of closely spaced undamped natural frequencies and moderate damping is given as an illustrative example. Useful information about the accuracy, the applicability, and the advantages of the proposed method over the exact method, as well as over the common procedure of ignoring the modal coupling, are derived.</p>