基于摄动分析的密频结构可控性研究

CONTROLLABILITY ANALYSIS OF STRUCTURE WITH CLOSELY SPACED NATURAL FREQUENCIES BASED ON PERTURBATION METHOD

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中文摘要

为研究密频结构频率密集度对结构可控性的影响，从密集频率结构的基本振动方程入手，针对三自由度的密频结构，采用摄动分析方法推导了闭环系统频率、阻尼比和摄动量的相关方程。在速度反馈和状态反馈情况下，讨论了结构频率密集度对结构可控性的影响，并对不确定参数对结构模态阻尼比的影响进行了分析。分析结果表明，对于采用速度反馈、位移反馈的闭环系统，随着结构频率密集度的降低，结构的部分模态阻尼比逐渐趋向于零，相应的结构模态趋于不可控。考虑了结构刚度和质量不确定参数对密频结构可控性的影响，结果表明不确定参数会影响密频结构不同模态之间的耦合程度，进而改变结构的可控度。

英文摘要

To figure out the influence of frequency intensity to the controllability of structures with closely-spaced natural frequencies, the paper established perturbation equations of closed-loop system between frequencies, mode damping ratios and perturbation parameters beginning from the basic dynamics equations. The analysis focuses on a three-degree-of-freedom structure with closely spaced natural frequencies. The velocity and displacement feedbacks are considered in the calculation. Calculation results suggest that the damping ratios of two modes are decreasing together with the decreasing of the degree of closely spaced natural frequencies which indicate that the controllability of corresponding modes are decreasing to zero. The uncertainties in mass and stiffness matrices are also included in the final part if this paper. Calculation results imply that the coupling degrees of different modes would be changed due to uncertainties and then the controllability will change.

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