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基于振动相对量法的齿轮敲击振动辨识

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Identification of gear rattle vibration by vibration relative approach

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摘要 整车转毂振动测试中测得的手动变速器箱体振动信号包含了多种部件的振动信号,传统方法无法从测试信号中直接获取齿轮敲击振动信号,故无法定量评价齿轮敲击振动水平。本文提出了运用敲击振动相对量来辨识齿轮敲击振动的方法。该方法首先对箱体振动信号进行人耳特性滤波,然后进行回归和平滑处理获得稳态振动信号。将滤波后的振动信号减去稳态振动信号,得到的振动相对量即为非承载齿轮对的瞬态敲击振动信号, 最终可辨识出齿轮敲击振动的发生时刻、频率范围和水平。在实车试验中,采用该方法在3.5 s的测试时间内,识别出振动相对量最大的134个齿轮敲击振动信号,其发生时刻与敲击振动信号回放得到的134个敲击噪声发生时刻完全相同,辨识结果与人的主观感受一致,即准确辨识出了齿轮敲击振动。得到的辨识结果可用于定量评价齿轮敲击振动水平,校核理论模型的正确性,研究不同参数对齿轮敲击振动水平的影响规律,找出关键影响因素并优化处理,从而改善齿轮敲击性能。

关键词 : 齿轮敲击, 齿轮敲击振动辨识, 敲击振动相对量法, 手动变速器

Abstract : Gear rattle vibration signals on the transmission housing caused by unloaded gear pairs are difficult to be identified and the rattle vibration levels can not be evaluated quantitatively, because many vibration signals are included in the transmission housing when the vibration signals are recorded in the full vehicle on a chassis dynamometer. This paper proposes a rattle vibration relative approach to identify the gear rattle vibration signals. Firstly, the vibration signals on the transmission housing were filtered by ear characteristic filtering functions, and steady vibration signals were extracted by regression and smoothing processes. Then, the relative approaches of the unloaded gear vibration were obtained by subtracting the steady vibration signals from all of the filtered vibration signals. The vibration relative approaches were taken as transient vibration signals of the unloaded gear pairs. Finally, the occurrence time, frequency and the level of the gear rattle vibration were identified. Through this method, 134 rattle vibration signals of the highest relative approach were identified within 3.5 s in the full vehicle test. The results show that the rattle occurrence time obtained by the relative approaches is entirely coincided with that of the 134 rattle vibration signals which are gotten by the vibration signal playback. The result of the gear rattle vibration identification is consistent to that of the subjective perception, namely, the gear rattle vibration is identified accurately. The results of the gear vibration identification can be used to quantify the rattle vibration level, verify the theory model of rattle prediction, research the effect rule of different parameters on gear rattle vibration level, find the key factors with high sensitivity to the gear rattle vibration level and to optimize gear rattle performance.

Key words : gear rattle gear rattle vibration identification rattle vibration relative approach manual transmission

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