基于节奏信息提取的虚拟低音增强算法

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**摘要：**中文摘要200字左右，应包括目的、方法、结果和结论等要素。

**关键词：**（小五号宋体）关键词需3~8个；关键词一；关键词二；关键词三

**中图分类号：**　　　　　　　　　**文献标志码：**A

**Virtual Bass System Based on Rhythm Content** **Extracting**

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**Abstract:** Bass effect is an important criterion for audio system. However, the small loudspeakers in portable devices have poor low frequency responses. Conventional methods to enhance the bass effect using equalizers does not help significantly and may result in distortion or permanent damage to the loudspeakers. Recently, the virtual bass system (VBS) based on the psychoacoustic phenomenon called “missing fundamental” has been proposed, whereby human auditory system can perceive the fundamental frequency from its higher harmonics. Nonlinear devices (NLD) and phase vocoder (PV) are commonly used to generate harmonics in VBS. Yet, both approaches have their strength and weakness. In this paper, we proposed a virtual bass system by extracting the rhythm content to improve the bass effect as well as maintain the audio quality. Experiments show that the bass effect has been improved significantly with maintaining the good audio quality and the processing efficiency has increased too.

**Key words**: key word one; key word two; key word thr

**1** 引言

随着移动多媒体设备变得更小、更薄、更轻，放置在这些设备中的扬声器也必须做到更小更薄。由于这些小型扬声器的成本和体积限制，使得它们不能够有很好的低频响应特性，但是低音效果又是衡量一个多媒体设备听音感受的一个很重要的因素，所以如何解决这个矛盾是目前音效增强领域的一个研究热点问题。传统的处理低音效果不足的方法是利用均衡器，通过对低频段信号的增益控制来达到增加低频信号能量的目的，但是这种方法往往会带来糟糕的低音效果和声音的失真，甚至会对扬声器的振膜带来不可逆转的损坏。

虚拟低音技术的出现对解决该问题提供了新思路，根据“基音缺失”理论，人的听觉系统感知声音的频率不单单是靠声源本身的频率决定的，还