

# 河南箏樂「滑顫音」之聲學分析-以曹桂芬演奏的五首曹派箏曲為例

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## 摘要

The phonological expression of Henan zheng school is very rich and charming. Besides the basic left-hand fingering skills such as yin, nao, hua (glide), and chan (vibrato), there are many composite fingering skills which are unique to the zheng music of Henan school. Hua-chan is one of such unique skills which combine both gliding and vibrato characteristics in expression of a wavy motion and a delicate feeling in the acoustic sounds. In this paper, the fundamental pitch detecting technique proposed by Tolonen et al. is applied. The zheng audio signal is at first divided into frames and then filtered into channels. The enhanced summary autocorrelation (ESAC) of every frame is computed so as to precisely detect its fundamental pitch. The sound intensity, spectrum envelope and associated statistics, and overtone configuration are also computed to show the timbre characteristic of the hua-chan tones. Zheng works by Cao Gui-Fen, a master of Henan zheng school, are selected for detailed case study. Her zheng performances are sampled and analyzed to discover the patterns and rules in pitch, intensity, and timbre of the hua-chan tones. The results shows the hua-chan tones are played with glide-in-vibrato or vibrato-in-glide manner, i.e., vibrato tones ornamented with gliding or gliding tones ornamented with vibrato. According to the assembling order of the two fingering skills, as well

as the vibrato rates and vibrato extents, an abundance of playing techniques are enabled. The automatic content-based music analysis techniques are applied in the paper, which can delicately deal with the zheng audio signal and provide an objective summary for the various types of hua-chan tones. Our results will be found helpful in discovering facts and rules behind performance of zheng artists when playing hua-chan tones. The proposed model for the hua-chan tones will provide a visual demonstration to illustrate their richness of the transition in pitch, intensity, and timbre, even though within the context of the acoustic sounds of the Henan zheng school.

關鍵字：河南箏樂、滑顫音