Title: Cover Song Identification
using Music Harmony Features, Model and Complexity Analysis

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Abstract: Analysis of digital music and its retrieval based on the audio features is one of the popular topics within the music information retrieval (MIR) field. Every musical piece has its characteristic harmony structure, but harmony analysis is seldom used for retrieval. Retrieval systems that do not focus on similarities in harmony progressions may consider two versions of the same song different, even though they differ only in instrumentation or a singing voice. This thesis takes various paths in exploring, how music harmony can be used in MIR, and in particular, the cover song identification (CSI) task. We first create a music harmony model based on the knowledge of music theory. We define novel concepts: a harmonic complexity of a musical piece, as well as the chord and chroma distance features. We show how these concepts can be used for retrieval, complexity analysis, and how they compare with the state-of-the-art of music harmony modeling. An extensive comparison of harmony features is then performed, using both the novel features and the traditional MIR features. Based on this comparison, the best features are proposed for the final experiments of the CSI task, with a result of 88.9% retrieval accuracy for a dataset of 2,000 songs using chroma features. The two methods used in our experiments are dynamic time warping and machine learning, for both feature comparison and our experimental results. To facilitate our research, a stand-alone application *harmony-analyser* was created and published online. Capable of music processing of WAV audio files, this application is proposed to the MIR community for feature extraction and harmony analysis. We have also published a dataset of karaoke songs *Kara1k*, which has been used for our experiments and contains a unique selection of features and annotations for future work.

Keywords: music information retrieval, music harmony analysis, cover song identification, feature extraction, chord distance, chroma vector distance, karaoke dataset, dynamic time warping, neural networks