To Whom It May Concern,

As an opponent, I am writing the review for the Ph.D. dissertation "*Cover Song Identification using Music Harmony Features, Model and Complexity Analysis*" written by Ladislav Maršík. This dissertation is submitted to the Faculty of Mathematics and Physics at the Charles University. My review is structured into seven parts, which are 1) Up-to-dateness of the dissertation, 2) Structure and organization of the dissertation, 3) Completion of the dissertation objectives, 4) Assessment of the methods used in the dissertation. 5) Evaluation of the results and contributions of the dissertation. 6) Remarks and possible questions for the defense. 7) The overall evaluation of the dissertation.

Up-to-dateness of the dissertation
Music Information Retrieval (MIR) is an interdisciplinary research field that combines digital music analysis and information retrieval. MIR is a very focused research topic with many real-world applications such as music signal recognition and music recommender systems. This dissertation explores one important research direction in MIR: Cover Song Identification (CSI). It is a very up-to-date research in the MIR community, for example, CSI is one of the top tasks in the MIREX at the ISMIR conference. **Therefore, this dissertation tackles a critical and up-to-date research challenge**. From the industrial perspective, CSI can be potentially used e.g. in Pandora, Last.fm, Spotify, YouTube Music, or Amazon Prime Music to protect cover song copyright or make music recommendations.

Structure and organization of the dissertation
Apart from introduction and conclusions, there are 6 chapters in the dissertation, which are *Understanding the terminology, Related works, Music harmony model and harmonic complexity, Music harmony features comparison and CSI experiments, harmony-analyser application, and KaraMIR project and Kara1k dataset*. **The chapters are well organized in an easy-to-read flow**. On one hand, the dissertation follows a good logic from explaining the terminology and related work as research background and then to the author's own contribution and experiments; It makes an easy path for the readers to understand the CSI and general research motivations. On the other hand, there is still improvement space for the author to further connect the chapter of *KaraMIR project and Kara1k dataset* to the whole dissertation. It is a quite independent/isolated chapter. For example, cross referencing to other chapters may improve this issue.

Completion of the dissertation objectives
This dissertation has clearly defined the research objective as "*This thesis takes various paths in exploring, how music harmony can be used in MIR, and in particular, the cover song identification (CSI) task.*" Along with contributions listed in page 8, this dissertation has well studied music harmony in MIR by defining harmony model, harmony complexity and harmony features. In the

conclusion, the answers and statements to the research objectives are revisited to close the research loop. Therefore, **the research objective is well investigated and completed**.

Assessment of the methods used in the dissertation
The research methods such as literature review and algorithm evaluation are used properly in this dissertation. For example, the reviews in section 2.2.1, 2.2.2 and 2.2.3 are well conducted. Section 5.5 has implemented a harmony-analyser prototype with GUI to validate the applicability of the research (its code is also in GitHub). The evaluation method in section 6.4.3 is solid. Overall, the dissertation has conducted rigorous evaluation as well as real-world prototyping. **The research methods used in the dissertation are properly applied**.

Evaluation of the results and contributions of the dissertation.
Results and contributions of the dissertation are well evaluated. For example, in Chapter 5 and 6, the research evaluation processes are very well documented.

Remarks and possible questions for the defense
The author of the dissertation may consider to improve the research work by the following two question: (1) As CSI is a very focused research branch in the scope of information retrieval. Who will benefit the most by following your research? (2) For the harmony-analyser tool, is it possible to conduct a user study to test the usability and efficiency of the tool?

The overall evaluation of the dissertation
This dissertation has focused on a state-of-the-art research topic - Cover Song Identification. The research background is very solid. The research results have been published in a set of good/top conferences and journal. The research works in this dissertations have contributed the knowledge to the research of music information retrieval, in terms of research significance and novelty. **Overall, this dissertation fulfils the research contribution for a Ph.D. study**.

The author of the dissertation proved the ability to conduct research and achieve scientific results. In accordance with par. 47, letter (4) of the Law Nr. 111/1998 (The Higher Education Act) **I do recommend the thesis for the presentation and defense with the aim of receiving the Ph.D. degree**.

In *Brno*, *11.August.2019*

doc. Mouzhi Ge, Ph.D.
Katedra počítačových systémů a komunikací
Fakulta informatiky
Masarykova univerzita
Botanická 554/68a, 602 00 Brno