An Objective Approach and Web-based Tool for Systematically Evaluating the Difficulty of Music Scores for Educators and Performers

Amy Gillick & Eli Tilevich
Depts. of Music & Computer Science
{agillick,tilevich}@vt.edu

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Abstract

Assessing the relative complexity of a music score has been the subject of much debate and disagreement among musicians. Nevertheless, the ability to rank a music score's complexity has become essential in curricular recommendations, competition specifications, etc. Without a systematic and objective approach to assessing the complexity of a music score, this non-trivial cognitive task depends solely on individual opinions, a process influenced by personal biases and lacking common criteria. Additionally, people buying sheet music face great uncertainty when determining whether unfamiliar music matches their playing ability. This project puts forward an automated approach to assessing the relative complexity of a music score that is systematic and objective. As a proof-of-concept of the approach, we propose to develop an automated, Web-based application for music educators and performers. This research exploits a fundamental tenet that—for a given instrument—different notes, intervals, and key signatures represent dissimilar levels of difficulty, which vary depending on the performer's proficiency. Furthermore, difficulty levels also depend on parameters including tempo, dynamics, and articulation. The approach is twofold. First, experts rank the relative difficulty of these musical components for different playing proficiencies and instruments. Second, an automated algorithm applies this ranking to music scores and calculates their respective complexity. Once music experts agree upon the complexity ranking for a given level of proficiency, this approach will automatically calculate a music score's relative difficulty. This new automated approach has the potential to empower musicians to expeditiously assess a music score's suitability for the abilities of intended performers.

Keywords: performing arts; education; engineering; technology; music score complexity; automated musical analysis; digital music publishing; end-user computing;

1 Introduction, Innovation, and Significance

Which piano concerto is more difficult: Rachmaninoff's Second or Third? A newly appointed band director wonders if this new orchestral score is appropriate for a high school band, given that the clarinet and bassoon sections are quite advanced, while the flute and oboe sections are more novice. Music educators working on pedagogical guidelines for K-12 students are trying to decide whether a given piece belongs in the N or N+1 curricular level. A publisher wonders which audience to target when marketing new works. Performers, band directors, educators, and publishers encounter these non-trivial questions throughout their professional careers. Currently, the only way to answer these questions in a viable way is to carefully analyze music scores by hand, a tedious, error-prone, and time-consuming process. The stakeholders at hand would rather spend their precious time on more creative pursuits.

Can technology be created to help decode these persistent and challenging questions? Is it possible to provide such technology via an easy-to-use web-based tool that is accessible to any interested musician? The goal of this proposal is to develop an objective approach that will be realized as a web-based tool to systematically evaluate the relative difficulty of music scores, thus benefiting educators and performers.

1.1 Overview of Aims & Methods

This transdisciplinary project will create an automated, systematic, and objective approach to assessing the relative complexity of music scores. Musicians playing any instrument would readily acknowledge that different notes, intervals, and key signatures represent dissimilar levels of difficulty, depending on the performer's proficiency. Other parameters affecting how challenging a performer is likely to find a given piece include its tempo, dynamics, and articulation. We envision how the proposed approach will entail a two-step process: parameterization and ranking. To parameterize the proposed automated system, experts would decide upon the relative difficulty of musical components (notes, intervals, keys, etc.) for a given level of playing proficiency. Then, an automated algorithm would apply the decided-upon parameterization to rank music scores, so as to calculate their respective complexity. An optical character recognition (OCR) mechanism will be used to transform music scores into a computer-readable format. Hence, the proposed approach will save time and effort by automatically calculating a music score's relative level of complexity. To ensure wide applicability, we propose to realize this novel approach as an easy-to-use, Web-based application that can be readily accessed by music educators and performers alike.

1.2 External Funding Opportunities

The proposed project will create the preliminary results required to apply to the Information and Intelligent Systems (IIS) program at the National Science Foundation (NSF). Concomitantly, the created proof of concept will be used to seek additional funding from the National Endowment for the Arts. Finally, the PI's plan to submit this project for consideration for a Google Faculty Research Award.

1.3 Proposal Team's Qualifications

Putting the vision described above into practice requires a unique combination of knowledge and skills, both in music and computing technologies. Hence, the proposal team comprises faculty from the Departments of Music and Computer Science. Dr. Gillick possesses a rich and diverse set of experiences in music curricular development, contest adjudication, and performance, both on saxophone and bassoon. Dr. Tilevich's expertise lies in creating innovative computing technologies and practical tools in the areas of Software Engineering, Mobile Computing, and Computing Education; he is also a professionally trained clarinetist, with experience in music pedagogy and performance.

The investigators have an established history of collaboration, having played chamber music and commissioned new works together.

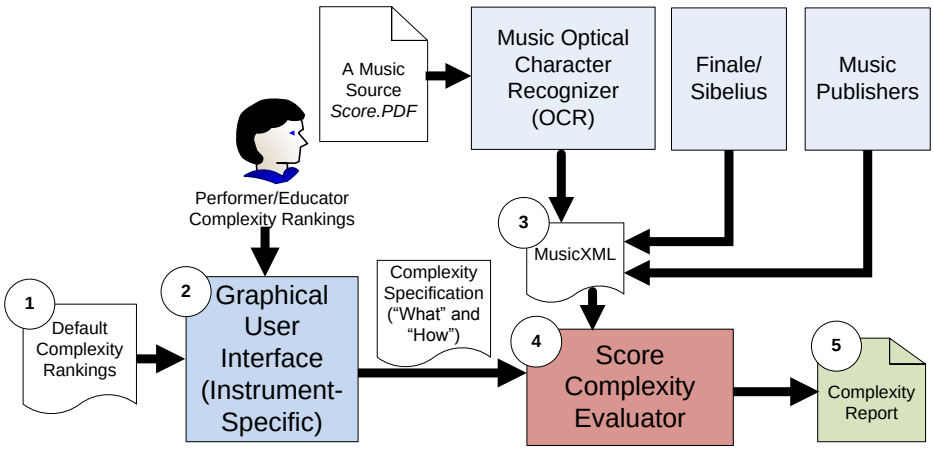

Figure 1: Control Flow of the proposed tool.

2 Technical Details

Figure 1 presents the control flow of the proposed approach. A performer/educator will be presented with a graphical tool to rank how complex they perceive the fundamental musical components for a given level of playing proficiency (label 2). To streamline this process, the tool will be parameterized with default rankings, which the user will be able to keep or override at will (label 1). The resulting rankings then will parameterize the score complexity evaluation module (label 4), which will compute and display a given piece's complexity metrics (label 5).

The evaluation module will accept music scores in the MusicXML format (label 3). There are three primary ways to obtain digitized music expressed in this format. First, an optical character recognition (OCR) technology can be used to convert PDF scores, which can be obtained via simple scanning, with a high degree of accuracy. Second, popular music notation software, including Sibelius and Finale, can export their scores in MusicXML. Finally, music publishers commonly use MusicXML as one of the internal formats for their scores.

3 Education and Engagement Plans

This new technology will serve as an effective educational tool that can increase the recruitment and retention of Computer Science students who are also interested in Music. In addition, this project will create state-of-the-art computing technologies that have potential to improve music pedagogy across a variety of instruments and genres. The impact of the proposed technologies would be recognized internationally due to the universality of musical language and the commonly faced problem of assessing the relative complexity of music scores. Finally, we envision these technologies having commercial viability, with large music publishers being the most likely first adopters.

4 Timeline & Budget

We are requesting funding in the amount of $3K for one semester (month 1—requirements gathering; month 2—developing an instrument-specific interface; month 3—developing the evaluation module; month 4—evaluation, assessment, dissemination) to hire an undergraduate or M.S. CS student with a background in music. A portion of this funding will be used to support the PI's travel to conferences to share the project's findings and deliverables.