

Changing Musical Emotion through Score and Performance with a Computational Rule System

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Abstract

This dissertation outlines the design, testing, and application of CMERS - a Computational Music Emotion Rule System for the control of perceived musical emotions. Musical emotion is changed through the application of empirically derived *music-emotion rules* (e.g., major mode \approx happy). These rules modify a work in real-time at the levels of score and performance, where existing computational systems have focused primarily on performance elements.

Six rules relating to the score, termed the *Primary Music-Emotion Structural Rules*, were examined in Round I testing with a system prototype. The prototype successfully changed the perceived emotion of selected musical works to all four emotion categories, described as: happy, angry, sad, and tender, with an average accuracy of 63%, and a multinomial logistic regression of $\chi^2(7) = 4128.27$, $p < 0.0005$ ($N = 11$). This result supported the use of structural rules, while highlighting the need for performance elements.

CMERS replaced the system prototype, possessing both structural and performance music-emotion rules. Expressive performance capability was also added, allowing for “humanistic” performance. In Round II testing, CMERS successfully changed the perceived emotion of selected musical works to all four emotion categories with an average accuracy of 78%, and a multinomial logistic regression of $\chi^2(9) = 11183.0$, $p < 0.0005$ ($N = 20$). This result supported the use of both structural and performance rules when changing perceived musical emotion.

In Round III testing, the accuracy of CMERS was compared with KTH’s Director Musices (DM), which focused primarily on performance rules. CMERS significantly outperformed DM across the four emotion categories, 82% to 57% (averaged), with a multinomial logistic regression

of $\chi^2(1) = 4.69$, $p = 0.0304$ ($N = 7$). DM reported similar accuracy ratings to the system prototype in Round I, with both sharing deficits for “anger” and “tender”. These results supported the need for controlling both score and performance when changing perceived musical emotion.

CMERS possesses real-time, fine-grained emotion modification capability allowing for its use in a variety of external application environments, such as computer gaming. As a research tool, CMERS provides a powerful mechanism for exploring the emotional and perceptual nature of individual music features through systematic modification.