REMUPP – An Interactive Tool for Investigating Musical Properties and Relations

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ABSTRACT

A typical experiment design within the field of music psychology is playing music to a test subject who listens and reacts – most often by verbal means. One limitation of this kind of test is the inherent difficulty of measuring an emotional reaction in a laboratory setting. This paper describes the design, functions and possible uses of the software tool REMUPP (Relations between musical parameters and perceived properties), designed for investigating various aspects of musical experience. REMUPP allows for non-verbal examination of selected musical parameters (such as tonality, tempo, timbre, articulation, volume, register etc.) in a musical context. The musical control is put into the hands of the subject, introducing an element of creativity and enhancing the sense of immersion. Information acquired with REMUPP can be output as numerical data for statistical analysis, but the tool is also suited for the use with more qualitatively oriented methods.

Keywords

Musical experience, non-verbal test techniques, musical parameters.

1. INTRODUCTION

"Each type of music comes with its own way of thinking about music, as if it were the only way of thinking about music (and the only music to think about)." (Nicholas Cook) [2].

Music – or what we in our society would call music – seems to be present in every known form of human culture [11]. In the contemporary western society, music is ubiquitous [8][10]. Music research of today is being performed by a multitude of disciplines, each with its own research tradition. To paraphrase the quote from musicologist Nicholas Cook above, it seems that each type of discipline comes with its own way of researching about music - as if it were the only way to research about music (and sometimes as if there were only one kind of music to research).

We have in our own research on the interdisciplinary borders

of music perception, emotion, sociology, technology, health and pedagogy increasingly felt the necessity of some kind of tool to help amalgamate some of the different views of the music phenomenon into a more coherent whole, to provide a common point of focus for different discourses to converge.

This paper describes the design, functions and some of the possible uses of the scientific evaluation and analysis tool REMUPP (Relations between musical parameters and perceived properties). REMUPP is a software-based interface designed for non-verbal testing of various musical functions – for use within several different disciplines of music research. It is developed by the Interactive Institute's studio Sonic in Piteå, Sweden and allows for investigating selected musical parameters in interplay with a musical and situational context.

2. METHODOLOGIES - BACKGROUND

2.1 Methodologies and Research Tools

Among the different fields of study investigating various aspects of the music phenomenon, especially music psychology has made extensive use of technological tools as a means for carrying out research in practice, performing experiments and collecting empirical data. The advent of the recording technology provided the possibility to exactly repeat a musical performance. This was a feature that was quickly embraced by the field of music perception and cognition, since it well served the experimental style employed. Another technology picked up by music psychology researchers has been sound synthesis, which makes it possible to control the generation and timbre of individual musical sounds [5][9]. The early 1980's introduced MIDI (Musical Instrument Digital Interface) that put further musical control into the hands of the researchers, providing for a detailed command of performance properties such as tempo, dynamics, articulation, timing etc. In spite of all the technology involved, the basic experiment design has not changed much over the years. The key formula has remained the same: the researcher plays music to the subject, who listens and reacts. The technology for producing and controlling the musical sound is in the hands of the researcher. The subject's reactions are usually measured by techniques such as verbal descriptions, interviews, adjective lists, rating scales etc. [4]

2.2 Issues of Commonly Used Music Research Tools

In the type of listening tests mentioned, the response of the subject in no way influences the musical performance or expression. The music played might be a recording of live

musicians – or the music is performed by the means of MIDI and synthesizers (although often a recording of a computerized performance is being used in the test situation) [7]. The use of a computerized musical performance has the advantage of offering detailed control over structural as well as performance related aspects of the music. Musical parameters such as intervals, tonalities, rhythms, articulations, accents etc can be isolated and controlled, turned into variables or constants – in manners ideal for and consistent with traditional scientific research. A drawback with this approach though, is that the resulting music often shows only remote kinship with music that we normally listen to and enjoy in life. Not seldom, musical examples designed for scientific experiments will be short snippets or phrases played "out of context". Also, some elements of the music might be perceived as sounding "unnatural". The reason might be that the researcher wishes to keep certain musical parameters constant while varying others, or it might just be due to lack of music programming skills - or simply for using substandard sound generators.

Juslin & Sloboda [6] mention the general difficulties of trying to study emotions in laboratory experiments. Using music that is experienced as sounding strange, unnatural or even bad, will further add to those difficulties. Another limitation with traditional standard music listening tests is, as mentioned earlier, how the control of the musical material usually is all in the hands of the researcher. This further accentuates the artificial nature of the experimental situation. In our daily lives we are used to selecting the music we listen to – at least when it comes to music that we like and actively seek because of that. And not only do we select the music, we also usually select the situation when we want it to play – and by doing this we also select and determine its function! [3]. Therefore, an experimental approach offering the subject influence over the musical conditions would increase the ecological validity of the experiment.

3. USING THE REMUPP TOOL

The MIDI-based software tool REMUPP offers all the control and advantages mentioned earlier in the discussion of using MIDI and synthesizers for listening tests. To this REMUPP adds several features, of which the more salient are: the ability to manipulate musical parameters in real-time – and putting the musical interaction in the hands of the test subjects. By manipulating controls presented graphically on the computer screen, subjects can change the expression of an ongoing musical piece by adjusting structural and performance related musical parameters like tonality, mode, tempo, harmonic and rhythmic complexity, register, instrumentation, articulation,

etc. The basic musical material, as well as the types and number of musical parameters included with REMUPP, can be varied and tailored by the researcher according to the needs and purpose of the study at hand. The music can also be combined with other media elements such as text or graphics.

Having the subjects manipulate the music, makes REMUPP a non-verbal tool where the subjects responds to the musical experience within "the medium of music" itself, without having to translate the response into other modes of expression such as words or drawings. By responding to the musical experience in this way, the user will directly influence the musical expression – and thereby to a certain degree control his/her own experience. This way, dimensions of creativity and interactivity are introduced into the test situation. Managing the parameter controls requires no previous musical training. In a typical REMUPP session, the controls will be presented without any verbal labels or descriptions, making for an intuitive use of the parameters with a focus on the musical sound itself.

The possibility to have several variable music parameters simultaneously available opens up for studying not only the individual parameters themselves, but also for investigating the relationships and interplay between the different parameters. Combining the music with other media such as text or video makes visible the relationships between music and other modes of expression. In REMUPP, the subject's manipulations of the parameters controls are recorded into the software and can be output in the form of numerical data, available for statistical analysis. Furthermore, the resulting music (including all the manipulations) can be played back in real time, making it possible to study the creative process as well as the aural end result. The various ways to handle data, and the possibility to combine different data types, makes the REMUPP tool potentially available for use within several different types of research disciplines. As well as being a source of quantitative statistical data, REMUPP is also suited for use with more qualitatively oriented methods like stimulated recall sessions, interviews, subjective assessments, open surveys etc – or for combinations of different techniques. Initial experiments indicate REMUPP to be a valid tool for investigating musical parameters [1].

4. TECHNICAL IMPLEMENTATION

The REMUPP tool is a MIDI-based software, handling dynamic, variable music. The software technically consists of five major blocks: the *Session Logic*, *Subjects' User Interface*, *Administrator's User Interface*, the *Music Player* and the *Result File* (see Figure 1).
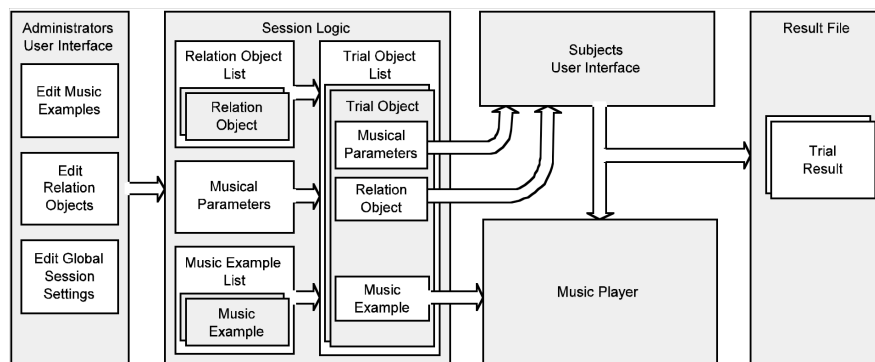

Figure 1

4.1 Session Logic

The Session logic holds a number of data types: *Music Examples*, *Relation Objects* and *Trial Objects*.

4.1.1 Music Examples

The Music Example is the musical raw material that REMUPP uses to assemble a variable musical performance. A Music Example consists of a set of properties used as basic input to the Music Player (see section 4.4) that selects from and modifies the Music Examples' raw material and in real time assembles the music played. The most prominent of the Music Example properties is the reference to a Standard MIDI File (SMF). The other properties give basic constraints for the music manipulation, such as maximum and minimum tempo and original key of the music in the SMF.

4.1.2 Relation Objects

Relation Objects are the objects to which the music should be related. A Relation Object consists of a name and a media file, for example a JPEG-file or a QuickTime movie.

4.1.3 Trial Objects

When a new Session is initiated, the Session Logic creates a set of discrete trials by combining the Music Examples used, the Musical Parameters and the Relation Objects, into Trial Objects. The Trial Objects are then stored in a list in random order. When a Trial is chosen from the list in order to be presented to the subject, its Music Example is loaded into the Music Player and its Musical Parameter(s) and Relation Object (if used) are loaded into the subject's graphic user interface (GUI).

4.2 The Subjects' User Interface

The Subjects' User Interface consists of a sounding part and a graphical part. The sounding part consists of music played by the Music Player (see section 4.4). The graphic part consists of one or more controllers (e.g. faders and buttons), each of them assigned to a particular Musical Parameter of the Music Player. Depending on the test design, there might also be a Relation Object (e.g. graphics or text) as part of the GUI.

When a Trial is completed, the Session Logic stores the settings made and then gets the next one from the Trial Object list.

4.3 Administrator User Interface

In the Administrator's GUI the test designer makes settings for coming sessions. The Administrator's User Interface mirrors the Session Logic. The test designer can create and edit Music Examples, Relation Objects and make global session settings.

4.3.1 Edit Music Examples

Music Examples are created, edited and tested using the Edit Music Examples window.

When editing a Music Example, the administrator will typically perform tasks like:

Naming the Music Example and link it to a standard MIDI-file (SMF).

Setting basic musical properties such as original key of the music in the SMF, defining the allowed modes (like the choice of major or minor modes), tempo boundaries etc.

Creating and editing instrument sets.

Creating and editing harmonic and rhythmic complexity levels and transposition levels.

In the Edit Music Examples window, all the Musical Parameters included in the current test are available at the same time. This way the administrator can make sure that the music reacts in a musically relevant way when the controllers are manipulated.

4.3.2 Edit Relation Objects

Relation Objects are created and edited using a dedicated interface, where media files such as graphic or text objects can be added to a list, displayed and selected for use.

4.3.3 Edit Global Session Settings

In the Global Settings dialog, the test designer can build a list of music examples to use in a session from the list of Music Examples known to the application.

4.4 Music Player

The Music Player assembles in real time a piece of music based on two inputs. The first input is a Music Example object that supplies the musical raw material to the Music Player. The other input is a number of Musical Parameters that are used to influence the way the Music Player uses the raw material to assemble the final music. Figure 2 shows the relation between the Music Player, the Music Example and the Musical Parameters. It also shows the internal structure of the Music Player.
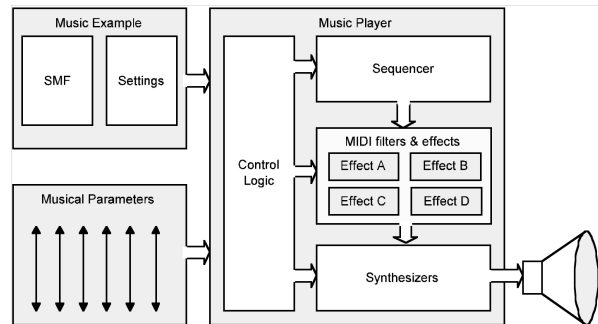

Figure 2

The musical raw material fed to the Music Player from the Music Example, consists of MIDI data read from a Standard MIDI File (SMF) pointed to by the Music Example. The SMF is loaded into the Music Player's MIDI-sequencer. The Musical Parameters are used to influence the behavior of the Sequencer, to manipulate the MIDI-data it contains and the way the MIDI-data finally is rendered to sound by the Synthesizers. The Musical Parameters are of three different kinds:

1. Parameters that control the Sequencer. The 'tempo' parameter is one example.

2. Parameters that control the Synthesizers used to finally render the music from the MIDI stream. 'Instrumentation' is one example.

3. Parameters that acts as filters and effects on the outgoing MIDI stream. These parameters are in turn of two different kinds:

   a. Filtering out MIDI-messages by muting and unmuting tracks of the SMF. 'Rhythmic complexity' is one example.

b .Manipulating individual MIDI-messages. 'Articulation' is one example where the length of notes is altered.

4.5 Result Files

During a Session, the subject's manipulation of the Musical Parameters is recorded. These recordings are saved in the Result File together with data from the Music Examples and Relation Objects used. File formats used are both proprietary and standard tab-separated text formats. The text formats are used for import to software such as Excel or SPSS.

4.6 Technology Used

The different versions of the Remupp application are developed using Macromedia Director and Sibelius SequenceXtra. The MIDI music is rendered using various third party synthesizers.

5. MUSICAL IMPLEMENTATION

The concept and functionality of the REMUPP interface causes special demands to be put on the structure of the basic musical material involved. Since the technical and musical designs will be interwoven with and interdependent on each other, the construction and implementation of the musical material becomes as important as the technical design. Unlike music created for more conventional use, the music composed for REMUPP must in a satisfactory way accommodate the parameter changes made by a test subject. The desired expressional effect must be distinctly achieved at the same time as the overall music performance should remain convincing. Special consideration also has to be taken of the complex interaction of different parameters working together, since the perceived effect of any selected parameter change will be affected by the prevailing settings of the other parameters available. The musical material can thus be thought of as an algorithm, where each parameter is put in relation to all the other parameters in a complex system interacting on many levels. The composer must therefore carefully define and tailor the basic musical material to fulfill the demands of the experiment at hand – as well as take into account the technical framework of REMUPP.

6. DISCUSSION

REMUPP offers a potential for investigating a range of music-related issues from new angles, offering alternatives when compared to traditional test methods. Firstly, the non-verbal nature of the interface allows for attaining types of data that are difficult or impossible to access using verbal descriptions. Secondly, REMUPP provides opportunities for exploring various aspects of contextual relations, intra-musical as well as extra-musical. Thirdly, the subject's interaction and control of the musical expression, allows for investigation of the creative dimension and establishes a deepened sense of agency for the subject. The emphasis on interactivity and the high quality music engine provides an environment resembling a computer game, which enhances immersion and effectively works against the otherwise potentially negative effects of the laboratory situation.

Control, participation, creativity and agency are increasingly becoming factors of our everyday listening experience. It seems that in a typical contemporary listening situation, the listener is far from passive [3]. Generally, we carefully select our music according to situation, personal preferences and desired functions. New digital formats offer flexible access and facilitate active control over the musical material at hand which affects our listening habits. For example, the use of music in computer games actually introduces musical manipulation on parameter level to users in everyday situations.

In this paper, emphasis has been put on the use of REMUPP as an interactive non-verbal tool suited for research of various aspects of musical experience. It should be noted however, that the technical and musical concepts behind REMUPP also offer a platform for other potential applications. For example, the system provides an interesting environment for the creation and concept development of live interactive music performances. Also, the REMUPP concept can be thought of as an embryo for a "musical engine" to be used for computer games and other interactive situations. Some of these possibilities will be presented in forthcoming projects and papers.

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