

Sound quality preference of violin tones and its directional dependence

Zdenek Otcenasek and Jan Stepanek

Music Faculty, Academy of Performing Arts, Prague, Czech Republic
(Hudebni fakulta AMU, Malostranske nam. 13, 118 00 Praha 1, CZECH REPUBLIC)
E-mail: OTCENASEK@HAMU.CZ

Summary: The goal of this study is to describe the directional dependence of sound quality preferences of violin tones. This space was scanned using 98-microphone position method, described in [1]. Only the tones played on free violin strings (G3, and A4) were used. The psychoacoustic listening tests were provided to find preference value for sound in space surrounding the instrument. New listening test **Context-Reduced Rating method** (CRR) was developed and used. Preferred area shapes are marked in graphical form and discussed.

1. INTRODUCTION

Perception of sounds in musical practice is connected with their aesthetic influence on listener. When we focus on separate tones (basic elements of musical information) we can observe listener preferences for some tones. These tones have higher perceived sound quality value.

Perceived sound quality of musical instrument sound is determined by the amount of radiated energy in individual spectral components, which are captured by the auditory organ and perceived by the listener. Relations of values of individual spectral components determine loudness and timbre of tones.

Loudness and timbre of a steady-state tone played on a musical instrument varies according to listening place around the instrument. The causes for this variability are differences in energy distribution radiated from the source in various directions and frequencies.

In space surrounding the instrument are places in which listener prefers the sound. The goal of this study was to try out a method for mapping instrument-surrounding space in point of view of perceived sound quality preferences.

As it is not possible to pre-determine width of unvaried areas or gradient of changes in sound of a specific instrument, it is necessary when measuring to divide the whole sphere surrounding the instrument into a large number of small segments with one microphone in each. Considerable similarity of recorded sounds requires application of sensitive methods of listening tests used for subjective assessment of these signals (e.g. dissimilarity pair test [2]). However, the enormous number of recordings eliminates their direct use. For example, 98 recordings generated 4753 pairs, which cannot be processed within a reasonable time. In order to reach the goal – finding of perceived sound preference values – it was necessary to prove new method preserving sensibility of pair test but less time-consuming.

2. METHODS

The **98-microphone method** [1] was used to map sound changes in space surrounding the instrument. François Gand (1825) and Carl Ludwig Bachmann (1766) violins were played by a violinist, *mezzoforte*, *detache*, *naturale*, *non-vibrato*, in an anechoic room. Only free string tones were played to eliminate pitch variability, the variability in loudness was checked and corrected.

Recordings were made using microphones arranged in a circle with a diameter of 3.2 m or 1.6 m respectively and in a plane perpendicular to the floor. The plane of microphones was raised from the floor by 0.5 m so that five consecutive recordings were made using sixteen microphones, in addition to two recordings using nine microphones (see FIGURE 1).

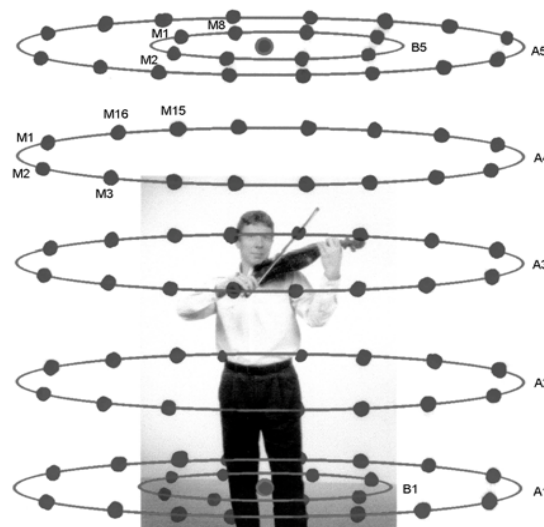


FIGURE 1. A configuration of microphones and violin position during recordings. Microphone sets are denoted from A1 to A5 and B1, B5.

Signals from sixteen/nine microphones on one plane were simultaneously recorded by two ARC88 sound cards (16 bit, 44.1 kHz). An SPL of recordings was equalized to the distances: instrument center – microphones in A3 plane.

For the assessment of preference values was developed and used **Context-Reduced Rating method** (CRR) which allows repeated comparison and by listener selected reduction of listened sounds. The CRR test was prepared on PC in the MATLAB® (The Mathworks, Inc.) environment (screen copy is in Figure 2).

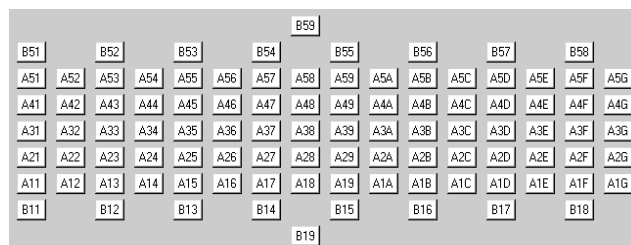


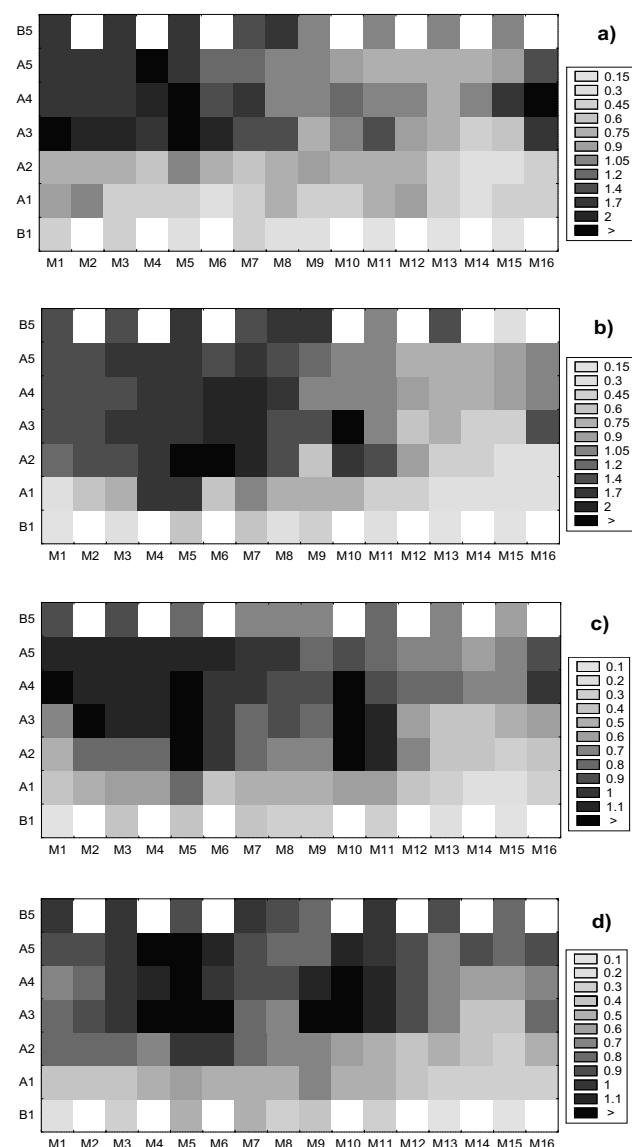
FIGURE 2. PC screen in preference test of 98 signals using CRR method. Each rectangle button represents the signal of one microphone. The buttons are organized in rows according to planes of microphone positions used in the measurement (bottom-up: B1, A1–A5, B5), one row displays an expanded circle of 16 or 9 microphones from a single plane.

Mouse clicking on the selected screen button played corresponding sound. The respondent's task was to determine sound preference value. He/she may precise and verify the preference value assigned to the particular signal by its comparing with another signal arbitrary selected and listened. Through this selection he/she progressively precised rating by listening to similarly rated signals without necessity to listen and compare all signals.

The sounds were listened in closed Sennheiser HD 250 linear II headphones; the SPL was equal to equalized SPL of recordings.

3. RESULTS

Tones G₃ and A₄, played on open strings were used for the test. Preference values were rated on a scale from 0 to 4, where 0 was assigned to very bad and 4 to very nice sound. The result examples for one listener are in FIGURE



3.

FIGURE 3. Results of CRR test: a) tone G₃ Gand, b) tone G₃ Bachmann, c) tone A₄ Gand, d) tone A₄ Bachmann.

4. DISCUSSION

It is noticeable from FIGURE 3. that areas with higher values of sound preferences (dark colors) are for both instruments and for both pitches concentrated to space area above right half of the top plate (sound post part). As very bad (light colors) were marked sounds from space area under back plate (around musicians feet) and area in musician shadow. Very good solo instrument Gand and medium quality Bachmann instrument have similar areas of high quality sound which are in good agreement with the position of microphone usually used for music recording.

The same or similar quality tones may differ in timbre as can be seen from results made in [3] for Bachmann instrument. When the sounds differ in loudness then louder sounds sound fuller and were in test more preferred.

5. CONCLUSION

Performed listening tests showed that CRR method is feasible for listeners according to time and technique. The method permits better orientation of the listener in judged context of stimuli. Respondent has higher feeling of surety in assigning the right value. In opposite to the classical methods of pair comparison without possibility to repeat the stimuli, CRR method refines and stabilizes values on the scale.

ACKNOWLEDGMENTS

The research was supported by the Ministry of Education and Youth of the Czech Republic (Project No. 511100001).

REFERENCES

- [1] OTČENÁSEK, Z., ŠTĚPÁNEK, J. (2000): Violin Sound Radiation – Directivity of Violin Timbre, DAGA 2000, Oldenburg, 240-241.
- [2] WEINREICH, G. (1997): Directional tone color, J. Acoust. Soc. Am., 101 (4), 2338 - 2346.
- [3] OTČENÁSEK, Z., ŠTĚPÁNEK, J. (2001): Directional Timbre Spaces of Violin Sounds, Proceedings of ISMA 2001, Perugia, 495-498.