PROCEEDINGS of the
23rd International Congress on Acoustics

9 to 13 September 2019 in Aachen, Germany

The role of attack transients in timbral brightness perception

Charalampos SAITIS[1]; Kai SIEDENBURG[2]; Paul SCHULADEN[3]; Christoph REUTER[4]

[1] Centre for Digital Music, Queen Mary University of London, United Kingdom

[2] Department of Medical Physics and Acoustics, University of Oldenburg, Germany

[3] Audio Communication Group, TU Berlin, Germany

[4] Institute of Musicology, University of Vienna, Austria

ABSTRACT

Evidence from acoustical modeling and multidimensional scaling of timbral brightness dissimilarity and general timbre dissimilarity ratings of natural instrumental sounds [Saitis & Siedenburg, in prep.] suggest that the brightness dimension in the general timbre dissimilarity space is not "purely" spectral. Specifically, when two sounds have very similar centroids of spectral energy distribution but different onset characteristics, listeners appear to employ temporal or spectrotemporal cues from the latter to resolve brightness judgments. This finding seems to challenge the typical approach of seeking acoustical correlates of timbral brightness only in the spectral envelope of the steady-state portion of sounds. Furthermore, it relates to the fact that acoustic instrument sounds exhibit an inherent correlation of spectral and temporal features. To further investigate the specific acoustic and cognitive factors that affect brightness ratings of musical tones, it was examined how timbral brightness is perceived for highly controlled sounds. Twenty musically experienced listeners performed a MUSHRA-like task involving synthetic harmonic complexes varying along three parameters: spectral centroid, log attack time, and fluctuation of spectral centroid over the first 100 ms. The latter models the progressive expansion of the spectrum toward the higher harmonics. A linear mixed model analysis confirmed the predominant role of spectral centroid in determining perceived brightness, but an influence of asynchrony in the rise of harmonics was also observed: When two sounds with identical spectral centroids and attack times varied in the "arrival" of higher-harmonic energy, faster-appearing upper harmonics tended to lead to higher brightness ratings. Log attack time did not seem to singlehandedly affect the perception of brightness, but its interaction with harmonic rise asynchrony appears to be of relevance to the listener. Overall, this experiment will help to clarify the relation between two major factors in timbre perception: onset and spectral energy distribution.

Keywords: Timbre perception, Timbral brightness, Attack transients

ACKNOWLEDGEMENTS

Kai Siedenburg has received funding from the European Union's Framework Programme for Research and Innovation Horizon 2020 (2014-2020) under the Marie Skłodowska-Curie Grant Agreement No. 747124.

[1] charalampos.saitis@mail.mcgill.ca