defines the instrument in terms of its average spectra. Specific tones are produced by the dynamic spectral envelope model by forcing its amplitude, fundamental frequency, and spectral centroid to match control functions which may or may not be generated from actual sounds. This model tests the power of the spectral centroid as a timbral control parameter and the spectral envelope family for defining a timbre class. For a particular instrument, the trumpet, listening tests indicate that the average listener can only detect differences between original sounds and sounds synthesized by this model about 50% of the time. Limitations of this model are expected to spur the development of further useful control parameters. For example, one limitation of the model is that, due to the averaging process in producing the spectral envelopes, it tends to generate time-varying spectra with small deviations between adjacent partials. Greater deviations, similar to those found in actual instrument sounds, could be restored by use of a new control parameter designed for this purpose. However, the best way to define such a control parameter is still an open question. Examples of sound synthesis using the dynamic spectral envelope model will be presented.

Perceptual Evaluation of Principal Components Analysis as a Data Reduction Tool for Musical Timbres

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Harmonic analysis and additive re-synthesis of musical instrument tones has been a fundamental tool of timbre research and synthesizer engineering. The considerable size of the datasets that are generated in the application of this technique has hindered its widespread use, however. A previous study [Sandell and Martens, Proc. 1992 ICMA, pp. 34-37] has proposed the use of Principle Components Analysis as a tool for reducing the size of such datasets with no noticeable loss in quality. Since then, a perceptual study has been run to evaluate the effects of different levels of data reduction. Additive synthesis datasets of live- recorded clarinet, trombone and cello tones were analyzed with PCA and subsequently resynthesized with varying numbers of Principle Components (PCs). Tones were evaluated in two ways: finding the number of PCs necessary to make them indistinguishable from the originals, and a quality-rating task. Using rather ideal conditions (headphones, a soundproof booth, and feedback on correctness of responses), listener data showed that the number of PCs needed for an indistinguishable resynthesis fell right at the boundary at which a useful data reduction was achieved. However, a quality rating task showed that far fewer PCs (and thus achieving 40-70% data reduction) were needed to produce acceptable, nearly-indistinguishable tones. With post- processing to correct tiny flaws, and under natural presentation conditions (e.g. loudspeakers in reverberant environments) a far greater still data reduction is likely to be obtainable.

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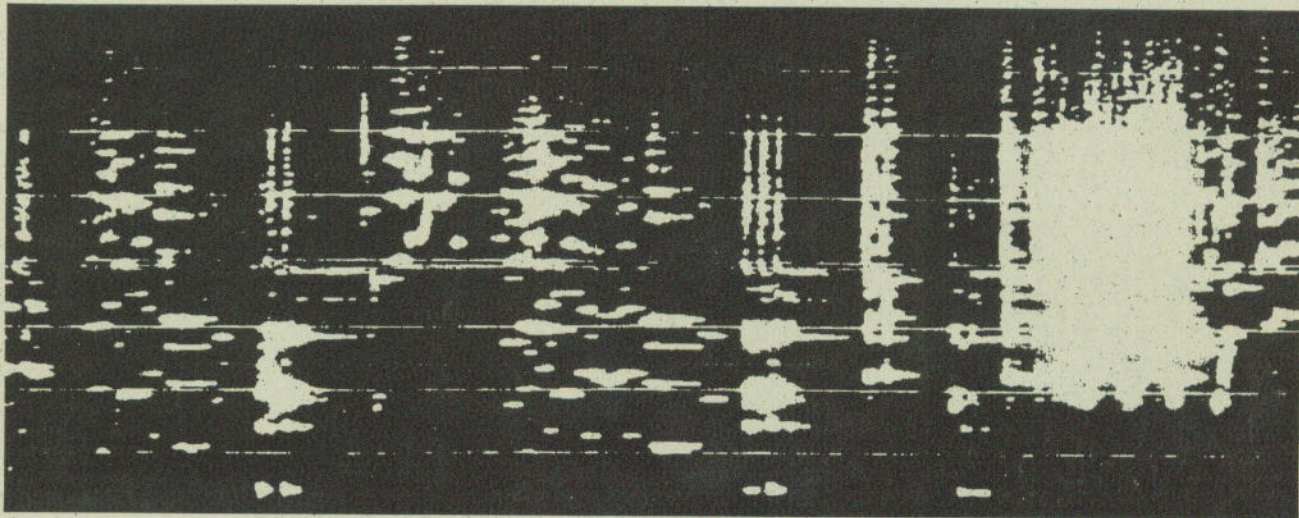

Adapted from R. Cogan's spectrum taken from Stravinsky's *Three Pieces for String Quartet,* Harvard University Press.

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