Statistical analysis of natural sounds.

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A babbling brook sounds quite different than rustling leaves or swaying branches. Such textured broadband sounds are common in nature. To discriminate among them, the auditory system extracts information from statistical regularities of these sounds. At the same time, it discards information about the particulars of each sound iteration. We constructed a library of natural sound textures recorded at high resolution, and performed statistical analysis to determine the dimensions in the sound space, which allow for their low-dimensional representation. Using wavelet analysis, the sounds were decomposed into fundamental building blocks, which could be randomly intermixed to construct novel sounds. We computed the statistics of the individual building blocks, and the statistics of their combination in different sound textures. This analysis was used to compose intermediate sounds: broad-band noise was gradually morphed into distinct sound objects, by systematically changing of the statistical distribution of the basic sound waveforms. We show that complex sounds can be generated from broad-band noise using a small number of statistical rules. This naturalistic sound library can be used in studies of neural encoding of higher-order statistics of sensory stimuli.

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