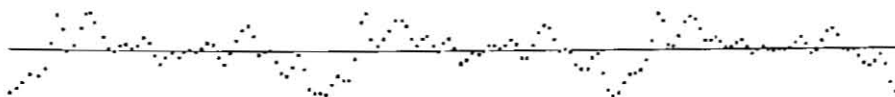


APPENDIX B

A Note on Digital Sound Files

Computer files of digital music with extensions such as '.wav', '.au', etc. (recorded either through the mike attached to the sound card or directly from a CD or tape recorder, or even generated synthetically) contain the sound data in the form of numbers representing the instantaneous amplitude of the sound recorded many thousand times a second. The sampling rate decides how many numbers are recorded and stored every second; the higher the number, the better the quality. The standard sampling rates are 8000, 11025, 22050, and 44100 times per second. The symbol Hz is used to denote the number of samples per second. The Audio CD recordings are at 44100 Hz. The numbers representing the amplitude usually range from -32768 to +32767, which is referred to as a 16-bit recording. If the range is 0 to 255, it is an 8-bit recording, which can distort the tone in some cases. Separate sets of numbers are required for the two channels in the case of stereo recordings.



A digital sound recording shown in graphic form. Each dot represents a sample and the distance of the dot from the central line is the amplitude of the sound at that moment. The sample shown here covers 1/100th of a second and covers about 3 periods — implying a fundamental frequency of about 300 cycles per second.

The highest frequency that can be correctly reproduced from a digital recording is half the sampling rate (the Nyquist limit). For a faithful reproduction of musical notes, the fundamental frequency of the note and the higher harmonics have to be recorded and reproduced. Thus, for a fundamental of (say) 192 cycles per second, which is usually the *sa* of female voices (5 *kattai* of Carnatic music), to record up to the 10th harmonic (1920 Hz), the sampling rate has to be at least 3840. For the Tara Panchamam, the minimum sampling rate required would be three times as much. A sampling rate of 11025 can record and reproduce up to 5512 cycles, adequate for Carnatic music voices (up to the 9th harmonic of Tara Panchamam for 5 *kattai*). Radio broadcasts in the AM band transmit frequencies up to 4500 Hz only. The upper limit of frequency that can be faithfully recorded with ordinary (analogue) tape recorders varies from 5000 Hz to 8000 Hz. Higher tape speed can increase the frequency limit proportionately.

Before recording music digitally, it is necessary to remove from the sound frequencies above the limit of half the sampling rate, as otherwise they will introduce some new unwanted sounds due to the phenomenon called 'aliasing'.