

Chapter 10 "Art of Digital Audio" Abstract

The subject of John Watkinson's tenth chapter is that of magnetic disk drives. Such technology manifests itself in today's audio industry through hard disk recorders and floppy disk storage. The basic mechanism of the magnetic disk drive involves a rotating store concept. Through the use of a rapidly spinning disk, data can be presented to the head repeatedly. With floppy disks, the magnetic medium is flexible and will change shape with differences in temperature and humidity. Since the head of a floppy disk drive comes in contact with the actual spinning disk, a spring-loaded pressure system is used to keep the head at a constant pressure with respect to the spinning plastic disk. Hard disk systems, on the other hand, are made from aluminum alloy. These metallic plates are then electroplated with a magnetic medium. Due to the metallic nature of this medium, the head cannot make contact with the actual disks. The hard disk head rides on a very thin cushion of air which protects it from the rapidly spinning disks.

There are several advantages of the hard disk medium over other digital audio recording methods. The main advantage is its ease of editing. Floppy disks necessarily rotate more slowly than hard disks, but both offer comparably high rates of information retrieval compared to other mediums such as magnetic tape. To access different sectors of information, all that is needed is for the head to simply move along the radius of the disk. Since disk diameters are relatively small (3.5" for contemporary floppy disks), this mechanical motion can be made quite quickly. Editing is therefore much faster and more precise. Also, since the editing does have to be done with the actual data files on disk, hard disk recorders can move editing functions to onboard RAM and thus allow for undo functions (non-destructive editing). The quick access time of hard disks also provides the advantage for immediate rewind and fast forward functions. No need for the musicians to anxiously wait until the tape spools back to zero while studio time is clicking away just to put down the next take. One of the current disadvantages of hard disk technology is that it does not enjoy the information density of magnetic tape recording. The use of a flying head with a deliberate air gap between it and the medium causes a severe separation loss which restricts the linear density available. A high-quality 16-bit 44.1 kHz stereo sample of audio, for example, requires one megabyte for every 5 seconds of recording time. A twenty-four track hard disk recorder, therefore, would need about 2.5 gigabytes of storage to compare with the 16 minutes of record time on contemporary professional analog 24 track machines. Furthermore, with 24-bit 96 kHz technology, this number jumps to almost 7 GB for a comparable 24-track recorder. It is only recently that computer technology has been able to keep up with these storage demands. As technology advances, however, certainly these numbers will become less impressive.

The error coding and correction mechanism for magnetic disk drives is much more intolerable to errors since this technology was originally developed for the computer industry. With non-audio computer data, methods such as concealment, interpolation, or masking are not possible as all pieces of the data are crucial for complete information retrieval. Numbers from a list of bank account totals cannot be averaged from the samples before and after a missing one since all the data is unrelated in quantity. There is generally no predictable pattern (if any pattern exists at all) to non-audio data. To guard against errors on magnetic disks, a list of bad-block files is written

onto the disk itself. When information is written to the disk it must be verified by the read head in order to confirm that the data was stored completely accurately. If the data is not verified, the area on the disk where the data was written is presumed to have some sort of flaw (probably a microscopic imperfection or bump in the disk) and thus added to the bad-block file. The data is then written to another sector of the disk which is still considered to be viable and the process repeats until the information can be accurately verified. When the disk is read or written, these bad blocks are merely skipped over. Presumably, a final advantage of the magnetic disk drive is that it does not have to rely on concealment (which is a process that seems to worry many hi-fi enthusiasts) since all of the recorded information has been confirmed.