ATRAC DSP Type-R

Sound compression Technique for Mini Disc

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1. ATRAC

1-1. What is ATRAC?

ATRAC is a shorten word of " Adaptive TRansform Acoustic Coding". ATRAC is a compression technique for Mini Disc. By this compression, the total sound data becomes approximately 1/5. (144.7kbps/ch)

As Mini Disc is recording system, it needs "Real time Encode & Decode".

1-2. Principle

(i) Recording

The input sounds are transformed into frequency spectrum elements. Then, the elements are analyzed and compressed. Finally, they are recorded on the Mini Disc.

(ii) Playback

The Frequency spectrum elements recorded on Mini Disc is taken out and transformed into sounds.

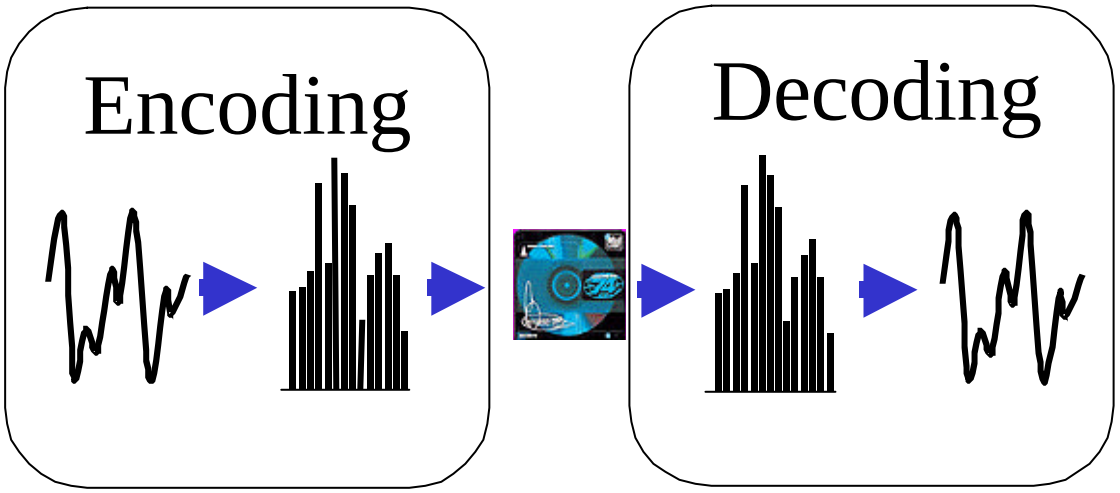

Fig. 1-1 Encoding & Decoding

1-3. Encoding

For example, a low frequency and high level sound is transformed to a low frequency and high level spectrum element.

Also, a high frequency and low level sound is transformed to a high frequency and low level spectrum element.

When these sounds are mixed, the mixed sound consists of two spectrum elements.

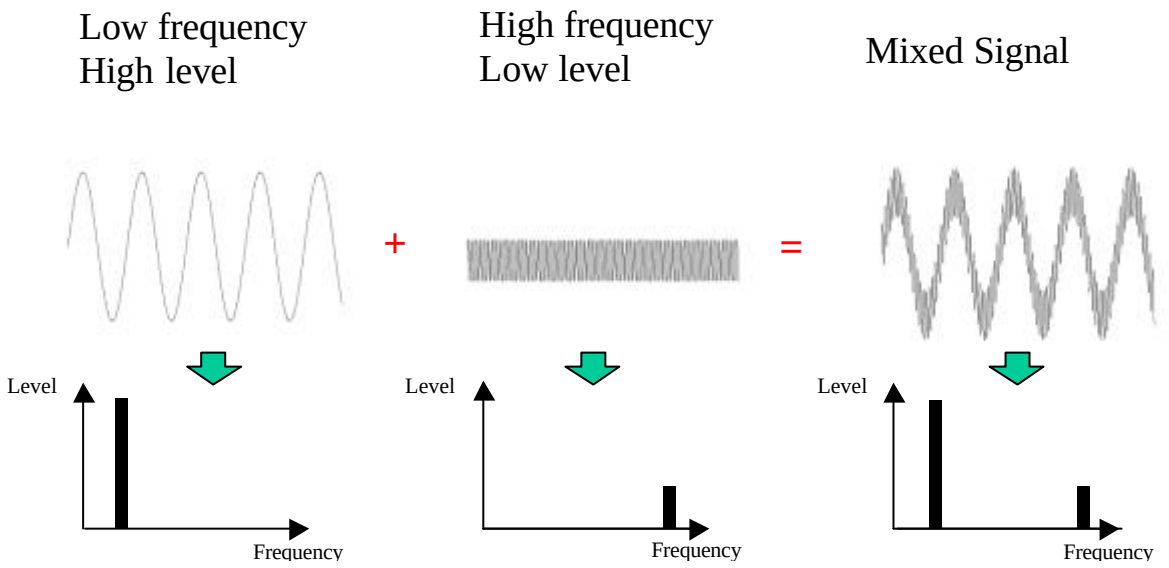

Fig. 1-2. Mixed signal

In this way, general and complicated sounds is transformed to many spectrum elements.

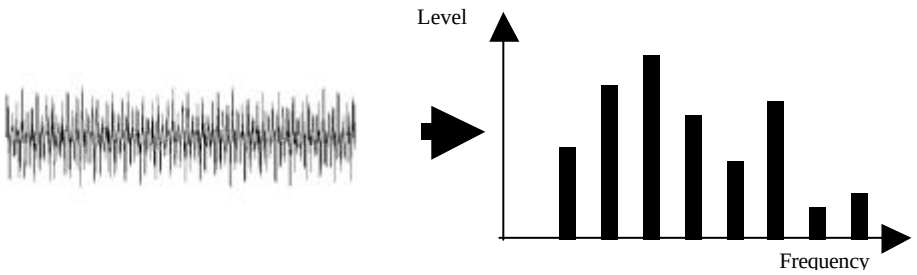

Fig. 1-3, Spectrum elements

These frequency spectrums are divided into blocks. The amount of blocks and the amount of frequency spectrum elements included in each block are specified by the ATRAC format.

The top line of block means normalized data that called "Scale Factor data". Generally, Scale Factor data is determined by the greatest frequency spectrum element within a block.

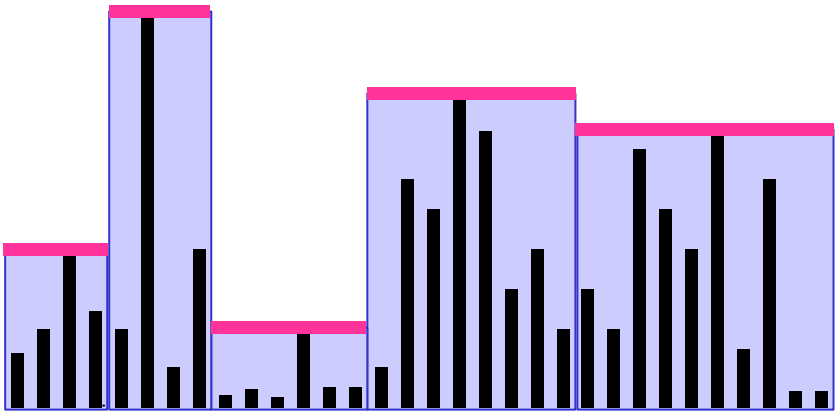

Fig. 1-4, Scale Factor

Frequency spectrum elements are analyzed and amount of bits allocated to each block is determined. The amount of bits allocated is called "Word Length data".

The larger Word Length data becomes the more precise the steps will be. Generally, Word Length data of a less important block is small. When the block is important, it will need more detailed information by minute steps.

This is the way compression is implemented.

The number of steps for quantizing each block is determined by Word Length data. But, the width of quantization varies with Scale Factor data.

For example, Word Length data of first block is the same as Word Length data of second block. But, the two blocks have different Scale Factors. As a result, they have different quantization width. In this way, the quantization is improved.

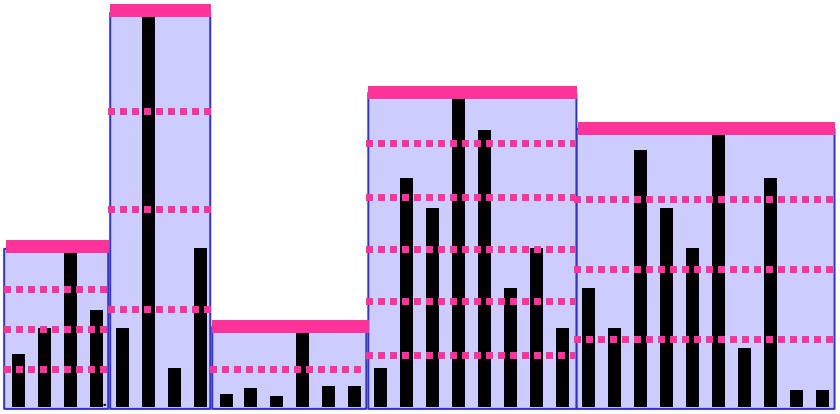

Fig. 1-5, Word Length

When bit allocation is completed, frequency spectrum elements are quantized in each block.

And, these quantized data is recorded on Mini Disc.

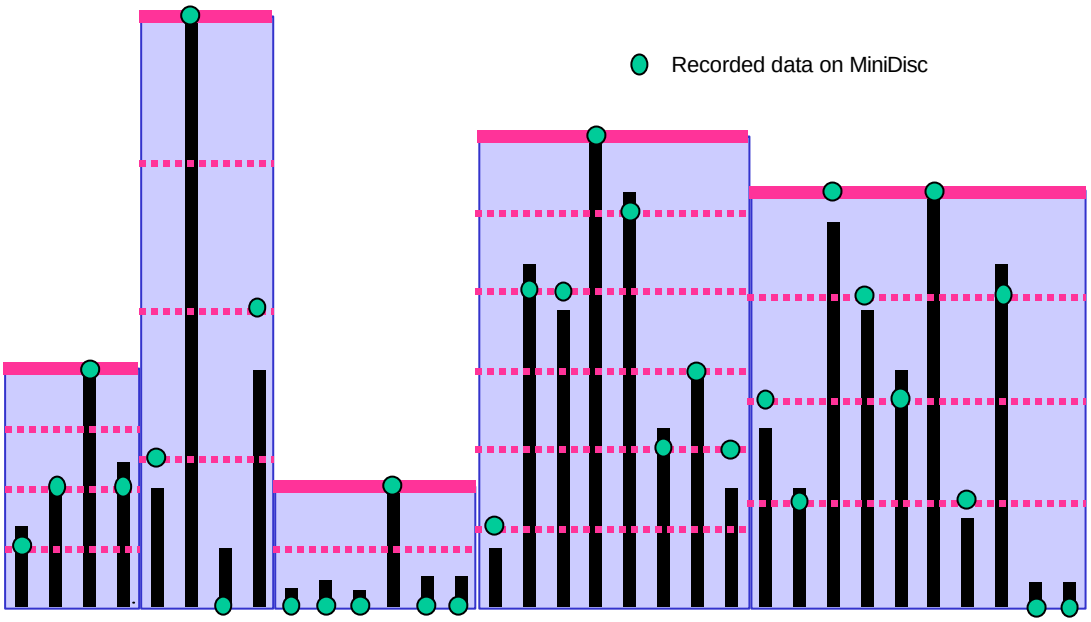

Fig. 1-6, Quantization

1-4. Decoding

The decoding is basically just inverse operation of encoding.

2. ATRAC DSP type-R

2-1. What is ATRAC DSP Type-R ?

ATRAC DSP Type-R is a new developed Digital Signal Processor. The "R" of Type-R means Reallocation, Refine, Reference and so on.

The version number of ATRAC is used for 1.0 to 4.5. But, since another company also started to use the ATRAC version number, it is getting to be complicated and sometimes it occurs some mistakes.

To make it clear, it is decided not to name the ATRAC in numbers, but to name ATRAC DSP Type-R. Therefore, the version number will not be used in the future.

2-2. Features

ATRAC DSP type-R which can double capability of data processing as compared with ver 4.5. Because of this, there are two technical features.

1. Upgraded computing accuracy
   ATRAC DSP Type-R will improve computing accuracy in every ATRAC processing steps.
2. Intelligent Bit Reallocation algorithm
   ATRAC DSP Type-R will analyzes again the quantified status which will be determined once. If more efficient bit allocation is feasible, the bit will be reallocated optimally.

2-3. Upgraded computing accuracy

ATRAC has many computing processes. Especially, transformation pat has many and complicated computing processes. And, the sound quality is greatly influenced by transformation.

As this new DSP has double-powered processing system, it is possible to use Block Floating operation effectively. Because of this improving, ATRAC DSP Type-R has an improved computing accuracy.

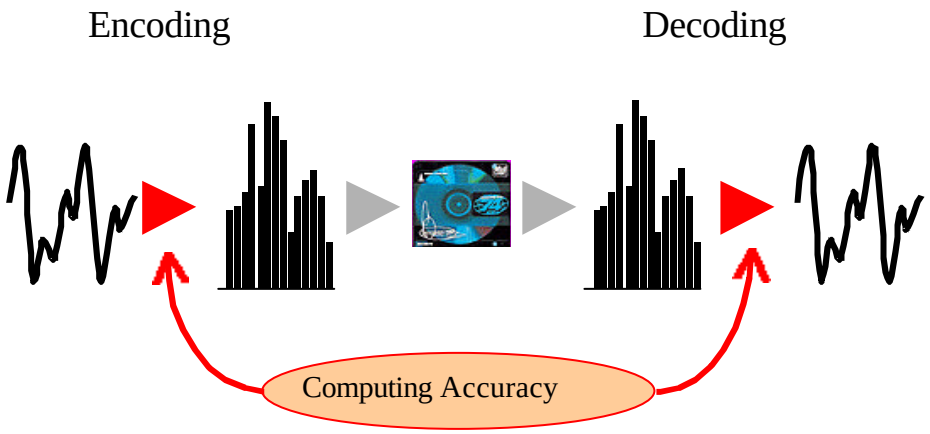

Fig. 2-1, Upgraded Computing accuracy

2-4. Intelligent Bit Reallocation

The procedure of existing ATRAC Encoding is as below.

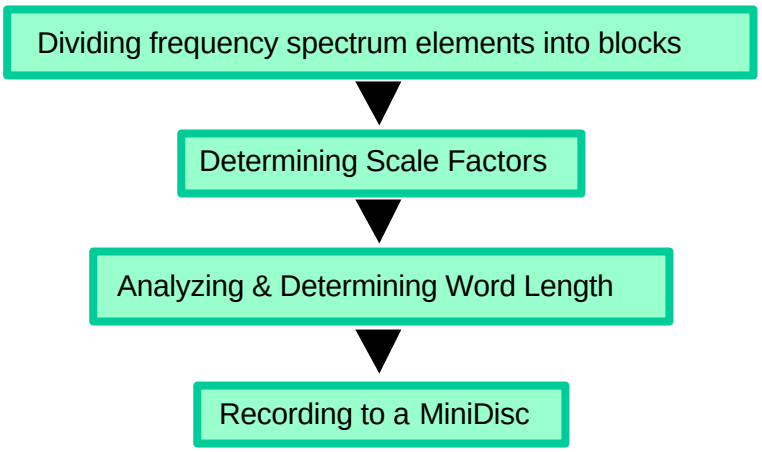

Fig. 2-2, ATRAC Encoding algorithm

Intelligent Bit Reallocation algorithm has two more processes, "Re-analysis" and "Re-adjustment".

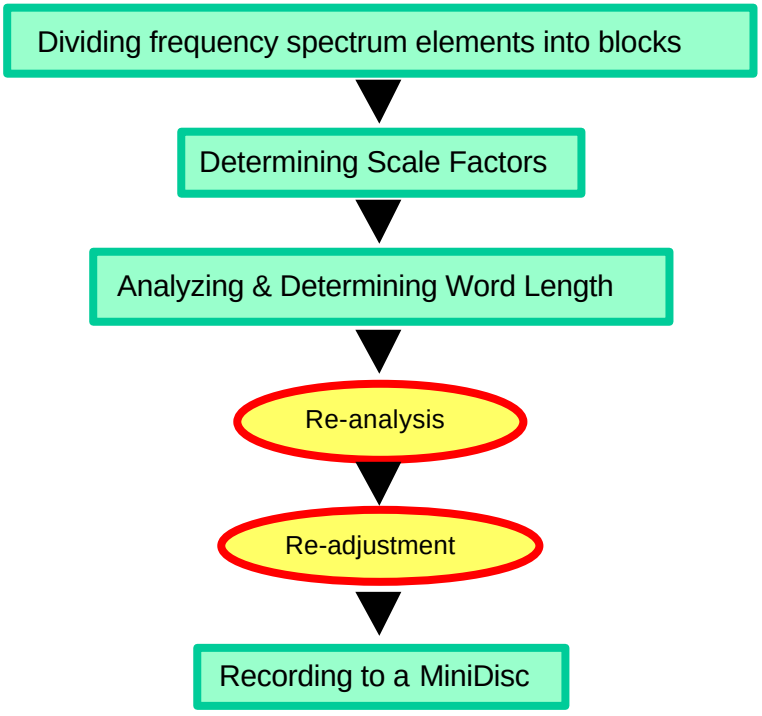

Fig. 2-3, Intelligent Bit Reallocation algorithm

New algorithm analyzes not only frequency spectrum elements but also quantized value. Re-analysis means comparing the optimum quantized value for each frequency spectrum elements. And, it analyzes state of quantization noise in each blocks.

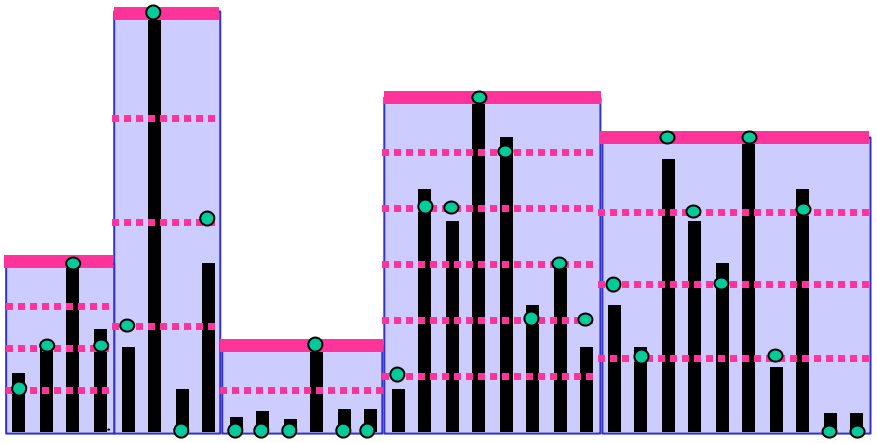

Fig. 2-4, Re-analysis

On the terms of Re-analysis, when the block has the important information, ATRAC allocates more detailed quantized steps to reach more optimum quantized value. This is Re-adjustment.

As a result, Intelligent Bit Reallocation algorithm can get more apporpriate Word Length data.

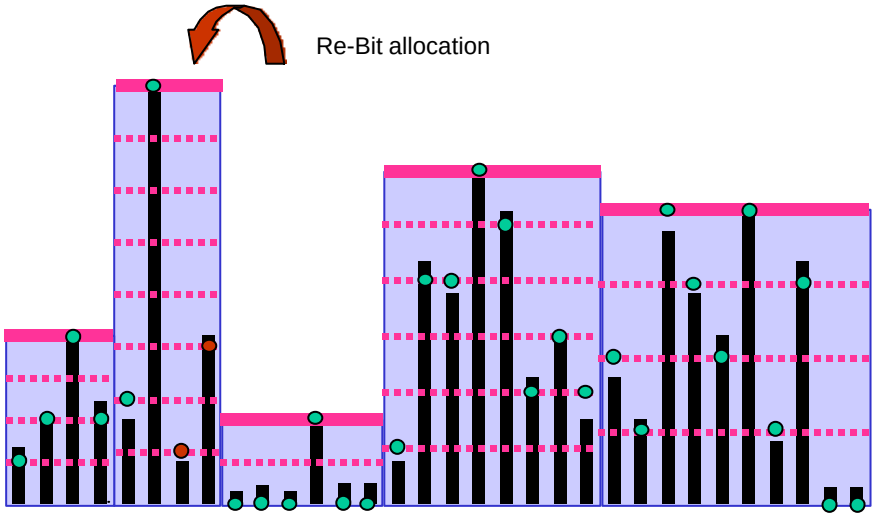

Fig. 2-5, Re-adjustment

Sony Corporation
Home Audio Company

Printed in Japan 1999.9

9-922-875-21

**Ptrinted by Quality Assurance Dept.
(Shinagawa)**