Candidate Number: EX0829

CM3065 Intelligent Signal Processing - Final Assignment

Exercise 2:

The application implements the Rice encoding technique as a data compression method. This approach involves encoding data in fixed-size blocks, which are then divided into a quotient component and a remainder part. The remaining part is a binary string representation of the remainder value, with a set number of bits, while the quotient part is a binary string of 1s followed by a 0 repeated as many times as the quotient value.

To perform the different phases of the Rice encoding method, the program employs five distinct functions. The first function, invert_byte, inverts a byte value bitwise and returns the resulting value. The second function, firstIndexZero, takes a byte and a starting index as inputs and outputs the position of the first 0 bit in the byte, starting at the supplied index. The third function, zeroBitsLeft, returns a bit mask with the specified number of zero bits on the left side, after receiving the requisite number of bits as input. The fourth function, Mask Right 1sBits, returns a bit mask with the provided number of 1 bits on the right side, after receiving the requisite number of bits as input. The fifth function, byte_length, takes a byte value as input and returns the number of bits required to represent the byte.

The encode_rice_algo function encodes a value using the Rice encoding technique. The function takes two inputs: the value to be encoded and the value of k, which specifies the number of bits that will make up the remainder of the encoded value. The function first determines the quotient and remainder parts of the input value before converting them into a binary string. The quotient component is encoded as a string of 1s followed by a 0 repeated as many times as the quotient value, while the remaining half is encoded as a binary string representation of the residual value, with a set number of bits.

To decode a value that has been encoded using the Rice encoding technique, the program uses the decode_rice_algo function. The encoded value and the value of k employed during encoding are the two inputs required by the function. The formula value = quotient * 2k + remainder is used by the function to first compute the quotient and remainder components of the input value before decoding them into the original value.

To encrypt a file using the Rice encoding technique, the program employs the file_encode_rice_algo function. The function requires three inputs: the name of the source file, the name of the destination file, and the encoding key value. When the function reads the source file byte by byte, it uses the encode_rice_algo function to encode each byte. If the encoded value is longer than a byte, it is divided into one-byte pieces and added to the output buffer. If the encoded value is less than one byte, it is packed into one byte, and the remaining space is filled with the next chunk. The output buffer is then written to the target file. The program utilizes a 256 KB buffer size to read data from the source file.

Otherwise, to decrypt the file , we use file_decode_rice_algo function. It basically works the back way of file_encode_rice_algo to decrypt the file encoded before.

	original size	Rice (K = 4 bits)	Rice (K = 2 bits)	% Compression (K = 4bits)	% Compression (K = 2bits)
Sound1.wav	978 KB	1.44 MB	3.92 MB	978 KB	978 KB
Sound2.wav	984 KB	1.50 MB	4.14 MB	984 KB	984 KB

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