NASA TECH BRIEF

Lyndon B. Johnson Space Center

Binary Concatenated Coding System

The problem:

In many instances, data encoding by either delta (differential) modulation or a fully encoded scale is relatively inefficient. To understand the approach incorporated in each, consider a measurement application which uses a 1-meter rod divided into 1-centimeter intervals. If a given length were measured and processed by non-ambiguous encoding, the readout would be a numerical value of the measured length in centimeters; that is each centimeter would be numbered. Delta modulation, on the other hand, measures unit intervals so that centimeters are not numbered. The user would, therefore, have to count centimeter lines to obtain the numerical value of a measurement.

The solution:

A binary concatenated coding system simplifies many types of measurements by using 3-bit binary words to count numbers from 0 through 99.

How it's done:

The binary concatenated coding (BCC) system utilizes a decade type measurement scale which is divided into specific intervals. In each decade, integers 1 through 7 are described by 3-bit data words expressed in the binary system as 001 through 111, respectively. The number 8, normally expressed in binary as a four-digit 1000, is depicted as 000. Numbers 9 and 10 are coded depending on the decade by binary 2, 3, or 4 for 9 and 4, 5, 6, or 7 for 10. Thus, 9 described in binary 2 and 10 described in binary 4 would indicate the second decade, etc. This would correspond, for example, to the 10th centimeter on the meter scale.

In use, this coding is applicable to any measurement which has an integer scale up to 100. The user who records a measurement through this coding obtains a decimal number from 1 through 10 as a 3-bit data word. This word is the last digit of the recorded value. To establish the decade (first digit) in which this reading is taken, he has to scan to the left on the readout and check the coding of the first 9's and 10's that he encounters. From this he can deduce the exact measurement value. This technique is highly competitive with pulse code and delta modulation for slowly varying measurements where continuous data readout is desirable.

Notes:

1. This system using 6-bit data words can be expanded to read from 1 to 10,000, and 9-bit data words can increase the range to 1,000,000.
2. This code may be "read" directly by observation after memorizing a simple listing of 9's and 10's.
3. Requests for further information may be directed to:
   Technology Utilization Officer
   Lyndon B. Johnson Space Center
   Code JM7
   Houston, Texas 77058
   Reference: TSP73-10083

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
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(MSC-14082)

Category 09