observers dimensions were being changed. All units of dynamics such as mass, velocity, acceleration, density, force, work and energy, can be expressed simply in terms of Newton's fundamental and absolute or universally constant units of time (T) and length (L), the one dimension of space or a volume L^3. The density of a mass (M) described in units of time (T) and lengths (L) is M/L^3, an acceleration L/T^2. A force is the product of a mass and an acceleration, and if the concrete units of time and length are reduced, so are all forces applied to an atom's mass, and the total amount of work the atom will perform, its total energy, is also reduced. Where does the lost energy go? In Einstein's theory, nowhere. When his moving observer approaches the "constant" speed of light, its total energy is almost destroyed; it is a physical wreck. Einstein could not reduce the equal and opposite reactions of Maxwell's ether to the actions of the light wave, because his idol, Lorenz, in his other theory, the electron, had already forbidden the ether to perform work. Two equal and opposite laws for the one ether. Lorenz will one day find his way into the Guinness Book of Records as a greater destroyer of energy than King Canute.

Einstein was forced to limit the velocity of an atom to the speed of light because once his moving observer mathematically exceeded the "constant" speed of light, he would mathematically become a centre of negative energy and vanish down a black hole, proof that you can prove anything with figures. Einstein found himself with mass that tended to shrink when it moved by the value of his equation. To balance his books and satisfy the principle of the conservation of energy, he discovered rest mass, which allowed him to unshrink mass by the same value. He called his theory relativity because the total energy of each atom in the universe depended on the atom's velocity relative to a fixed and motionless point in space, all atoms being connected by bendable springs and flexitime clocks to conserve energy. Maxwell would have immediately dismissed Einstein's theory using the argument in Article 852 of his treatise, that the force acting between two "bodies" must be a function of their distance apart only, and if the force is a function of time or the velocity of the bodies, theory would not satisfy the principle of the conservation of energy.

Einstein's favourite occupation was performing what he called thought experiments. In the portable laboratory of his mind he could prove, without fear of contradiction, that scientific history was bunk. His laboratory was the envy of a few second rate accountants in a hurry. An analysis of debits and credits and their equal and opposite actions can be very time consuming, far easier to cook the books and make yourself a quick profit. They renamed Newton's laws the three laws of non-motion. If it moved you either saluted it or multiplied it by Lorenz's equation. Never in the understanding of a field of force, was so little owed by so many, to so few.

To be continued

A decimal Gray code

Easily converted for shaft position coding

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For some incremental measurements, such as shaft position coding, the Gray scale has advantages over b.c.d. coding as it changes by one bit only between adjacent codes. Unfortunately, it needs to be converted back into b.c.d. to give a read-out. Gray scale is difficult and therefore expensive to convert and this decimal Gray scale overcomes the difficulty.

The author has recently designed equipment to monitor wind speed and direction. The wind vane drives a slotted disc whose position is sensed by l.e.d./photo-transistor pairs. A code is required to sense the position of the disc and transmit this position to the display and recording equipment. The reflected binary, or binary Gray code shown in Table 1 has the required property that only one bit changes in adjacent codes, but is an expensive code to convert to a decimal form for display.

The decimal Gray code also shown in Table 1 is much cheaper to convert. It is "reflected" after each decade, and the low order bit of the next higher digit (b_0^1) is required for conversion. The b.c.d. digit ($b_3\ b_2\ b_1\ b_0$) corresponding to the decimal Gray digit ($g_3\ g_2\ g_1\ g_0$) is

$$b_0 = b_0^1 \oplus g_3 \oplus g_2 \oplus g_1 \oplus g_0$$
$$b_1 = g_3 \oplus g_2 \oplus g_1$$
$$b_2 = (g_3 \oplus g_2)\, b_0^1 + g_1\, b_0^1$$
$$b_3 = g_3\, \overline{b_0^1} + \overline{g_2}\,\overline{g_1}\, b_0^1$$

Whatever the code used, it will in general be non-reflective at the zero point in a scale used to measure shaft position. If the angle is to be measured in 1° steps the codes at the zero point are as shown in Table 2. Additional logic must be added so that the offending bits g_2^1 and g_1^1 are set equal to g_1^2 before conversion when $D_0 = 0$ and the last value of D_2D_1 when $g_0^0 = 1$ was 00 or 35. The logic required for the complete conversion is shown in Figure 1.

It should be noted that the zero point logic is more likely to be simple if a decimal rather than binary based code is used. For example, in the example described D_0 is reflective because the transition occurs at 360° which is an even multiple of ten.

Table 1: It will be noted that the most significant bit in the fifth column changes to 1 at a count of 16 whereas in the decimal Gray code it changes at a count of 10. In Table 2, D_0 to D_3 represent the decoded decimal number, while g_0^0 to g_1^2 is the decimal Gray coding

TABLE 1

	Binary Gray	Decimal Gray
0	0 0000	0 0000
1	0 0001	0 0001
2	0 0011	0 0011
3	0 0010	0 0010
4	0 0110	0 0110
5	0 0111	0 0111
6	0 0101	0 0101
7	0 0100	0 0100
8	0 1100	0 1100
9	0 1101	0 1101
10	0 1111	1 1101
11	0 1110	1 1100
12	0 1010	1 0100
13	0 1011	1 0101
14	0 1001	1 0111
15	0 1000	1 0110
16	1 1000	1 0010
17	1 1101	1 0011
18	1 1111	1 0001
19	1 1110	1 0000

Fig. 1. The logic required to convert a decimal Gray code for the digits 0 to 360 (g) into a BCD code (b). The elements on the left remove the ambiguity at the zero point ▶

TABLE 2

	D_2		D_1				D_0			
	g_1^2	g_0^2	g_3^1	g_2^1	g_1^1	g_0^1	g_3^0	g_2^0	g_1^0	g_0^0
349	1	0	0	1	1	1	1	1	0	1
350	1	0	0	1	1	0	1	1	0	1
351	1	0	0	1	1	0	1	1	0	0
.....										
358	1	0	0	1	1	0	0	0	0	1
359	1	0	0	1	1	0	0	0	0	0
000	0	0	0	0	0	0	0	0	0	0
001	0	0	0	0	0	0	0	0	0	1
.....										
009	0	0	0	0	0	0	1	1	0	1
010	0	0	0	0	0	1	1	1	0	1