in the sensory and motor pathways, both the $v_{i(t-d_i)}$ input and the $v^{j(t+d_j)}$ output of the central network are asynchronous. Thus, in the implicit metric (in contrast to the explicit system) the components of any given CNS vector need not represent external simultaneity. *The 'implicit' sensorimotor system does not separate a sensory and a motor metric, nor does it re-establish the external simultaneity anywhere within the network.* Such a network, as in Fig. 6, represents the true unified character of sensorimotor space-time metric in the CNS.

A concise intuitive interpretation of the functioning of such space-time coordinator networks can be provided based on the heuristic power of the metric tensor. Basically, this mathematical device expresses the relation between any invariant entity and its description by coordinates. It gives the algorithm for the internal reconstruction of the invariant entity itself from the distributed vectorial components ascribed to it. For example, given an OP distance (a line-element, which is an invariant of the physical world), the n coordinate components which describe OP are not invariant quantities (they depend on the frame of reference and also on the method by which the either covariant or contravariant components are obtained). While more than one feature (e.g. the x and y) of a physical invariant (such as OP) may be implicitly present in a single v_i value, these different features are encoded, 'scrambled' together in every v_i. Because of this method of 'scrambling', no single component may carry explicit information about a separate feature. Furthermore, no single component contains enough information to recreate the invariant. On the other hand, the full set of components, e.g. the v_i covariants, does contain the total information. However, to obtain the invariant, all the v_i components have to be assembled in a well defined manner. This particular 'manner' is given by the metric tensor: its matrix provides the coefficients (weights) of all the pair-products of the components v_i such that the sum of these weighted pair-products yields the physical invariant itself.

The 'scrambled' encoding can be illuminated through the notion of orthogonality. Indeed, in connection with our two-dimensional Euclidean illustrations, it is worth considering that the most fundamental (orthogonal) algebraic example of all 'metrics' is the Pythagoras theorem. It is basic knowledge that in a Cartesian frame a displacement D is encoded by both x and y in such a way that in order to reconstruct the invariant D^2 the components must be put together by adding their squares. This can be expressed not only algebraically but also by vector-matrix symbolism and finally by the reference-frame invariant tensor formalism:

$$D^2 = 1.x^2 + 0.xy + 0.yx + 1.y^2$$

$$= \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} . \begin{pmatrix} x \\ y \end{pmatrix} . (x, y) = g^{ij} v_i v_j.$$

That is, the metric tensor in an Euclidean 2-space is the identity-matrix, called Kronecker-delta δ^{ij}, where

$$\delta^{ij} = g^{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{if } i \neq j. \end{cases}$$

δ^{ij}, serving as a metric, reveals that (a) since it is an identity-matrix, the covariant and contravariant expressions are identical; (b) since the off-diagonal elements of the matrix are zero, the quadratic expression of the invariant D^2 contains no mixed terms. The lack of off-diagonals intuitively means that an individual component along on axis can express the invariant physical entity independently of any other component both in measuring a change (e.g. a displacement) of the physical entity and in generating a change. Thus, *the coordinates in an orthogonal system are separable*. Algebraically, if the off-diagonals of the metric are zero, the inner product of any two component vectors of a particular vector is zero. In the Newtonian frame, this is the case with not only the x, y and z space coordinates but also with the t time coordinate. This intuitively means that the displacement of an event is equal to the change of x itself (if y, z, t do not change). Moreover, the event-displacement is also equal temporally to the change of t itself (if x, y, z do not change). Thus, if the space-time metric contains no off-diagonal elements, there is a separable coordinate axis t.

Comparison of our symbolic example of a coordinate system in Figs 3–4 with the orthogonal Newtonian space-time frame reveals profound differences. Basically, no vector component in the non-orthogonal coordinate systems in the CNS can be equal to the invariant both in measuring its change and generating its change: the coordinates in an oblique frame are all interrelated in expressing the invariant. Similarly, time (in the form of temporal delays) is included in all coordinate axes, expressing a different delay in each (Fig. 4). There is no axis that measures time in the absence of a measure of space and vice versa; 'space' and 'time' information are, indeed, merged into a unified entity. *Thus, while a goal of the CNS is to establish an external coincidence of events, this goal has to be achieved by using space-coordinates inside the CNS such that each of them refer to a different external time-point.* The scheme of Fig. 6 (together with Fig. 5) provided a step-by-step explanation of the functioning of an 'implicit' space-time metric. A network identical to the one in Fig. 6 can be presented, however, in a layout which closely resembles the actual cerebellar neuronal circuitry (Fig. 7).

Here, the overall function of the cerebellar space-time metric is summarized by extending the tensor notation to the time variable. The central network (an assembly of lookahead-modules) transforms the delay-laden components of a covariant vectorial expression of an invariant space-time coincidence into contravariant, predicted vectorial components belonging to the same external invariant. This is