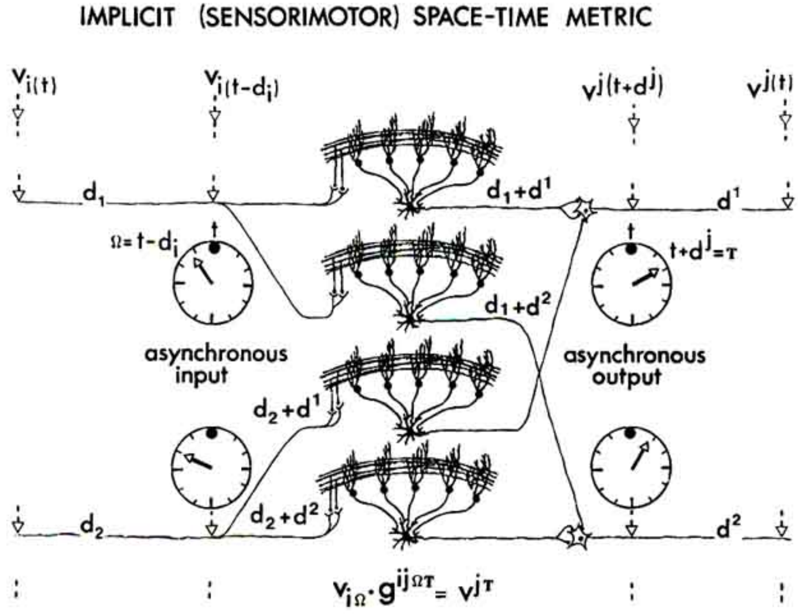

Fig. 6. Circuitry schematics of a network representation of an implicit space-time metric. The scheme is derived from Fig. 5 by contracting each pair of sensory d_i and motor d^j lookahead-modules into a single predictor module (yielding $n \times n = n^2$ modules altogether, contrasted to the $2n$ number of modules in the scheme of Fig. 5). Each lookahead-module (e.g. connecting the ith input to the jth output) provides a $d^{ij} = d_i + d^j$ temporal extrapolation. As a result, both the input and the output of such a network are asynchronous: the input vectorial components refer to $t - d_i$ external clock-times (they lag t by different delays), while the output signals refer to $t + d^j$ time-points (they lead t non-uniformly). No vector within such network represents external simultaneity.

can only be achieved by the motor system if a temporal lookahead d^j is included in each of the contravariant output lines.

Therefore, a sensorimotor transformation that contains delays both in the sensory- and motor pathways, as in Fig. 5, can be implemented by using 'lookahead modules' not only in the input but also in the output of the system. In Fig. 5B, the d^1 and d^2 temporal predictions compensating for motor delays are provided by the d^j lookahead-modules, transforming $v^{j(t)}$ into $v^{j(t+d^j)}$ so that the contravariant output that leaves the CNS *leads* the coincidence-time t by d^j. This output will produce exactly the $v^{j(t)}$ contravariant form when all the components undergo the motor delays d^j.

Because the network shown in Fig. 5 works on the principle of 're-establishing', by delay compensation, an internal synchrony among the sets of covariant and contravariant components, it can be considered a 'hybrid' system, a network comprised of asynchronous pathways yet internally representing synchronous vectorial components.

A central conclusion of this paper is, however, that *there is no theoretical need to separate the input and output delay compensations from the metric transformation itself.* Figure 6 shows a compact scheme in which the input and output lookahead modules of Fig. 5 are combined into a unified network implementing an implicit metric where the matrix elements (connecting lines between each input and output) themselves produce the required temporal prediction properties.

The transition from Fig. 5 to Fig. 6 is based on a contraction of the lookahead-modules. The input delay d_i and the output delay d^j in the path from the ith input to the jth output were combined so that the g^{ij} matrix-element (the number of connectivity-lines from the ith input to the jth output) incorporates a delay d^{ij}, where

$$d^{ij} = d_i + d^j.$$

Such 'compaction', while technically simple, introduces a significant conceptual change in the interpretation of the functioning of the network. It is a fact that in target interception the vectorial expressions at the sensory and motor coordinates, $v_{i(t)}$ and $v^{j(t)}$, respectively, refer directly to an identical space-time event point (cf. Fig. 5A). However, due to the delays