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177.1 TENSORIAL REPRESENTATION OF SPACE-TIME IN CNS: SENSORY-MOTOR COORDINATION VIA DISTRIBUTED CEREBELLAR SPACE - TIME METRIC.

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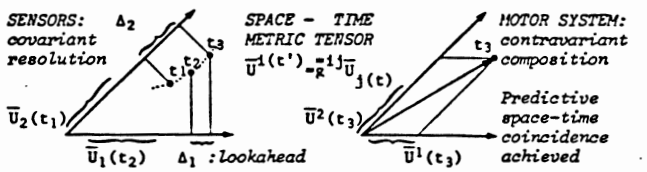
Locating and intercepting moving objects is a coordinated sensorimotor act, aimed at achieving a coincidence of the interceptor and the target. While both sensory and motor functions relate to space-time, the conceptual basis of how such union is established by the brain is ill-understood; e.g. usually *separate time and space representations are assumed* and timing is linked to the concept of *simultaneity* (established by a centralized clock). However, the brain cannot use this timing principle, since there is no instantaneous signal capable of establishing such simultaneity.

The proposed space-time concept is based on the tensor network theory of CNS (*Neuroscience* 4:323,1979), which states that brain function is tensorial; i.e. brain activity vectors, assigned to objects of the external world, have reference-frame invariant properties. We further indicated (*Neuroscience* in press,1980) that in the oblique CNS reference-frame sensory information is resolved into *covariant* vectorial components, while motor execution is composed of *contravariant* components. Thus; coordination was defined as the geometrical transformation of the motor vector from covariant to contravariant expression; the first featuring intention, the latter allowing execution.



This scheme provides a geometrical interpretation of the unified space-time operation in CNS. Because of the different delays in the pathways sensory information relates not only to the space coordinates of the target, but also to the time of occurrence of the event, *in the past*. This information is coded in the signal itself. Given the different delays inherent in the sensory covariants a set of transformations must take place to ensure appropriate motor response: (1) Motor execution must be contravariant and (2) must refer to a *future* space-time coincidence. *The above scheme is a unification of the notion on temporal lookahead by Taylor expansion and the notion of cerebellar function as a metric tensor:* the covariant, distributed space-time components are (1) extrapolated by a "lookahead" (2) transformed by the space-time metric tensor. (Supported by USPHS grant NS13742 from NINCDS)

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