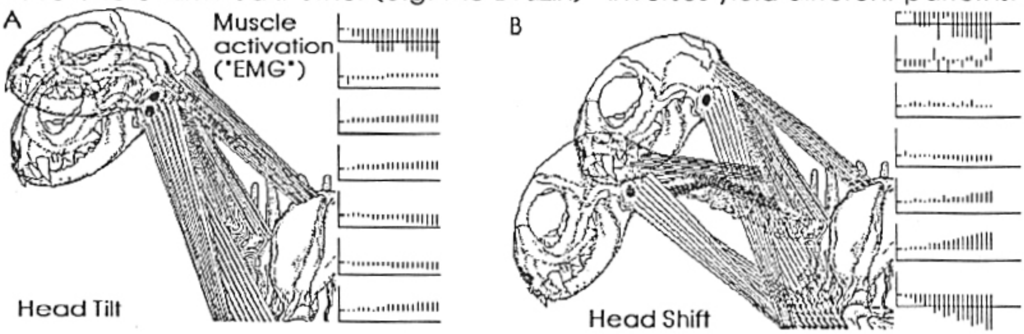
SOCIETY FOR NEUROSCIENCE 1987 ABSTRACT

MULTIDIMENSIONAL SENSORIMOTOR "PATTERNS" ARISING FROM A GRAPHICS-BASED TENSORIAL MODEL OF THE NECK-MOTOR SYSTEM.

J. Laczkó*, KFKI/MSZKI Budapest, Hungary, 1525, **A. J. Pellionisz,** Dept. Physiol. Biophys., New York Univ. Med. Ctr New York, NY, 10016, **B.W. Peterson,** & **T.S. Buchanan***, Dept. Physiol. Northwestern Univ. Med. School, Chicago IL, 60611. (SPON: G. Ostriker)

The general problem of how sensory reception is transformed, via neuronal networks, into motor execution led us to build a multidimensional tensorial model of the neuro-musculo-skeletal head control system of the cat *(Pellionisz & Peterson, 1987, in: "Control of Head Movement", Oxford U.P.).* The structuro-functional basis of the model is the availability of general (non-orthogonal overcomplete) coordinates that are intrinsic to neural, muscular and skeletal expressions of sensory and motor events. With the numerical values of muscle orgin and insertion points and a single center of head-rotation revealed *(cf. Baker & Wickland, ibid)* the tensorial model can provide experimentally verifiable predictions *(cf. Peterson et al., 1987, Proc. Symp. Biomech. & Neural Contr.).* When further developing this model, one of the considerations is that the center of rotation of the head/neck system is not fixed. This necessitates accurately modeling the skeleton. A further phenomenon to be accounted for by the model is that animals may use different muscle patterns when making a head movement in different paradigms *(Keshner et al., Soc Neurosci. Abstr, 1986).*

Thus, the tensor approach was extended with a graphics-based computer model *(Pellionisz,1987, In: "Comp. in Brain Sci.", Cambridge U.P.).* 2D diagrams of the skeletomuscular system were inputed. By specifying joints and muscle origin and insertion-points, the overcomplete non-orthogonal systems of coordinates were calculated. Predictions were made by the *Moore-Penrose* inverse, since the model requires the solution of an overdetermined system of equations. We have also examined if other (e.g. the *Drazin*) inverses yield different patterns.



A surprising result gained by this generation of tensor models is that with only slightly different movement-intentions the emerging movement-patterns can be drastically altered (see *tilt* around a *single* center in **A**, versus *shift* around *two* centers in **B**). The emergence of different CNS patterns is of great interest because it provides insight into how a single neuronal mechanism might yield different "synergies", "schemas" or "strategies" to coordinate the multitude of degrees–of–freedom of multi–joint movements given a desired trajectory.

Such tensor models are research tools for the interpretation of sensorimotor experimental data in several species. They can also be used to predict muscle activity which can be used both for direct comparison with EMG data and for studies related to functional neuromuscular stimulation. — Supported by NS 22999