SOCIETY FOR NEUROSCIENCE 1989 ABSTRACT FORM

Read all instructions before typing abstract.
See *Call for Abstracts* and reverse of this sheet.
Complete abstract and **all boxes at left and below** before making copy.

___ **Check here if this is a REPLACEMENT of abstract submitted earlier. REMIT $25 for each replacement abstract.**

First (Presenting) Author

Provide full name (no initials), address, and phone numbers *of first author on abstract. You may present only one abstract.*

ANDRAS J. PELLIONISZ
DEPT. PHYSIOL. BIOPHYS.
NYU MED. CTR.
550 FIRST AVE, NEW YORK
N.Y. 10016

Office: (212) 340-5422 Home: (212) 686-8910

SMALLEST RECOMMENDED TYPE SIZE: 10 POINT

SAMPLE:
1989 Annual Meeting
Phoenix, Arizona
October 29–November 3

DEADLINE FOR POSTMARKING:

MAY 1, 1989

Presentation Preference

Check one: ☐ poster ☒ slide

Themes and Topics

See list of themes and topics. Indicate below a first and second choice appropriate for programming and publishing your paper.

1st theme title: MOT. SYST. AND SENS.MOT INT. **theme letter:** G
1st topic title CEREBELLUM **topic number:** 88

2nd theme title: MOT. SYST. AND SENSMOT. INT **theme letter:** G
2nd topic title CIRCUITRY AND PATTERN. GEN. **topic number:** 94

Special Requests (e.g., projection requirements)

I WOULD LIKE TO SHOW A MOVIE OF FRACTAL GROWTH: SLIDE PRESENTATION, PLEASE.

Include nonrefundable ABSTRACT HANDLING FEE of $25 payable to the Society for Neuroscience, **DRAWN ON A U.S. BANK IN U.S. DOLLARS ONLY.**

FRACTAL GEOMETRY OF PURKINJE NEURONS: RELATIONSHIPS AMONG METRICA AND NON-METRICAL NEURAL GEOMETRIES. *A.J. Pellionisz* (Dept. of Physiolog and Biophysics; New York University Medical Center, New York, NY, 10016).

In one decade since inception of a geometrical approach to brain theory, an alternati was established to the untenable dogma that Euclidean geometry (with a Kronecker del as the metric tensor) is sufficient to account for structurofunctional features of the CN. In time, implications of *multidimensional geometrical concepts and formalisms* will b absorbed, intrinsic coordinate systems will be experimentally measured and thus featur of neural geometries that are spun over such frames will be established (e.g. spacetim geometry of sensorimotor transformations). *Sensorimotor system neuroscience* may lea this progress since metrical properties of skeletomuscular systems and their governin neural nets can be measured and multidimensional computational properties are to b used in neurocomputing, rehabilitation medicine and (neuro)robotics. Also, represent tion of distances (and judgements and decisions based on them) in functional spaces wit metric tensors that are characteristic to non-Euclidean spaces may become a conceptu and formal basis in *cognitive science* (theory of association of generalized vectors).

Raising sights above Euclidean spaces it is apparent that metrical properties c (quasi)linear, derivable multidimensional manifolds (e.g. those governing gaze) are bu the simplest features of neural geometry. It is known that if neural systems revert to nonlinear non-metrical domain, strange attractors emerge, revealing chaotic geometry. is postulated here that beneath a chaotic geometry (e.g. of EEG) and the functiona "smooth" metrical spaces it may relapse to, a third kind of neural "microstructure exists: *The growth of cellular (neural) elements reveals a fractal geometry* that is a direc manifestation of the process based on repeated access to the genetic code during growth.

The presentation demonstrates the fractal growth of dendritic trees of Purkinje cells displaying self-similarity of micro- and macro-features of the arbor, showing that the bi furcation-rule of branching expresses a fractal dimension, and revealing codes responsibl for generating normal or pathological arbors. Relation of growth- and functional model of neurons and neural nets is discussed; since fractal, metrical and chaotic neural geome tries of the micro-, medium- and macro-domains of the CNS are interdependent (just a relativistic-, Newtonian- and quantum-mechanics apply together to the external world).

KEY WORDS: (see instructions pg. 4)

1. FRACTAL
2. GROWTH
3. CEREBELLUM
4. PURKINJE CELL

Signature of Society for Neuroscience member required below. *No member may sign more than one abstract.*

The signing member certifies that any work with human or animal subjects related in this abstract complies with the guiding principles for experimental procedures endorsed by the Society.

[signature] A.J. PELLIONISZ (212) 340-5422

FRACTAL GEOMETRY OF PURKINJE NEURONS: RELATIONSHIPS AMONG METRICA AND NON-METRICAL NEURAL GEOMETRIES. *A.J. Pellionisz*

(Dept. of Physiolog and Biophysics; New York University Medical Center, New York, NY, 10016).

In one decade since inception of a geometrical approach to brain theory, an alternati was established to the untenable dogma that Euclidean geometry (with a Kronecker del as the metric tensor) is sufficient to account for structurofunctional features of the CN: In time, implications of *multidimensional geometrical concepts and formalisms* will b absorbed, intrinsic coordinate systems will be experimentally measured and thus feature of neural geometries that are spun over such frames will be established (e.g. spacetim geometry of sensorimotor transformations). *Sensorimotor system neuroscience* may lea this progress since metrical properties of skeletomuscular systems and their governin neural nets can be measured and multidimensional computational properties are to b used in neurocomputing, rehabilitation medicine and (neuro)robotics. Also, represent tion of distances (and judgements and decisions based on them) in functional spaces wit metric tensors that are characteristic to non-Euclidean spaces may become a conceptu and formal basis in *cognitive science* (theory of association of generalized vectors).

Raising sights above Euclidean spaces it is apparent that metrical properties c (quasi)linear, derivable multidimensional manifolds (e.g. those governing gaze) are bu the simplest features of neural geometry. It is known that if neural systems revert to nonlinear non-metrical domain, strange attractors emerge, revealing chaotic geometry. I is postulated here that beneath a chaotic geometry (e.g. of EEG) and the functiona "smooth" metrical spaces it may relapse to, a third kind of neural "microstructure exists: *The growth of cellular (neural) elements reveals a fractal geometry* that is a direc manifestation of the process based on repeated access to the genetic code during growth.

The presentation demonstrates the fractal growth of dendritic trees of Purkinje cells displaying self-similarity of micro- and macro-features of the arbor, showing that the bi furcation-rule of branching expresses a fractal dimension, and revealing codes responsibl for generating normal or pathological arbors. Relation of growth- and functional model of neurons and neural nets is discussed; since fractal, metrical and chaotic neural geome tries of the micro-, medium- and macro-domains of the CNS are interdependent (just a relativistic-, Newtonian- and quantum-mechanics apply together to the external world).