

BEAM or MFA I inspired Nv Neurons using op amps for line and line based polygon detection.

Dr Bheemaiah, Anil Kumar, A.B Seattle W.A 98125

miyawaki@yopmail.com

Dedication to my undergraduate thesis advisor Dr Radha Krishna Rao. Professor Emeritus IIT Chennai.

Abstract:

Tensor network topologies for function, first class or MFA I as BEAM circuits are described within the framework of complexity theory using Lie Computability definitions. An example of the design of opamp based Nv Neurons for the perception of shape from line detection Nv neurons is described, with circuits that detect number of lines and concavity and closure of lines in a finite region of interest.

The possible role of BEAM robotics in 3R's is described in nature inspired intent transcription, in multi-functionality and functionality driven evolution and transcription.

Keywords: BEAM, MFA I, MFA II, Lie Computability, op amp circuits, Nv Neurons, Two Port Systems, large signal analysis, feedback principles, solitons, neuro-modulation.

What:

Nv Neurons are built from opamp based circuits, for line detection using an array or grid of inexpensive photo detectors, using an opamp based positive feedback loop and negative feedback loops for synergy principles.

Story: The author first worked on this problem in his undergraduate senior year, when his advisor advised a bottom-up approach to BEAM based machine vision, biomimetics in synthetic neurons from discrete components and opamps. The problem was to differentiate a simple polygonal shape from the background.

How:

A simple polygon is found in traffic sign posts, creating the need for a hard wired circuit to recognize an octahedral stop sign and several triangular signs. We use line decomposition with a circuitry to compose the lines into polyhedral shapes.(Bheemaiah, n.d.)

Why: BEAM is functional art, and forms the predecessor to MFA II or completely multi functional architecture of a broad umbrella of value addition in multi functionality, functoid and HOF based algebraic frameworks for MaC based definitions of architecture and design in code.(Autores and



Octagon: Exclusively used for Stop.

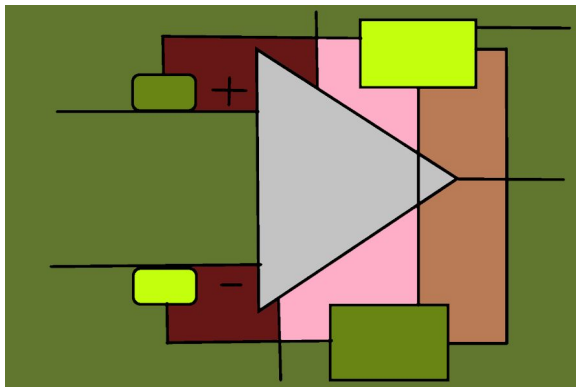


Equilateral Triangle (One point down): Exclusively used for Yield.

(Mark n.d.)

Introduction.

BEAM robotics was pioneered by Mark Tilden, and since it contains the word 'aesthetics' in it, it finds its place in both the humanities and the sciences. The author has pioneered the use of BEAM in autopilot systems, 3R's model systems and its use in approximationism in art therapy. (Hrynkiw, Tilden, and Tilden 2002)



("Nv Neuron by Bheemaiaha on DeviantArt" n.d.)

Problem Definition.

Given a Line L in a Background B, there exists a circuit of Nv Neurons [Nv], for semantic segmentation to objects defined by the shape. [Hexagon, Triangle]. We define a Nv neuron for line segmentation and a set of neurons [Nv] for shape segmentation, one for hexagons, $He=[Nv]$ and $T=[Nv]$ for triangle segmentation.

The circuit graph of a Nv Neuron as denoted in CaC is an opamp(in+, in-, out), impedance_mux_i, $i = 1$ to 4 , impedance_mux_opamp+(in, out), impedance_mux_opamp-(in,out),

impedence_feedback+(in,out) and
impedence_feedback-(in,out).

The circuit graph is straightforward from these elements with the impedance being a complex value with a multiplexed hard wired control bus, [in+,in-,fb+,fb-], with various values for various circuit topologies.

Amplification differential amplification uses negative feedback with gain and bandwidth tradeoffs, while positive feedback leads to a whole universe of noise based computing and signal theory (S/N ratio) in two port analysis, of dynamical systems, with stable orbits called oscillations ,leading to stability theorems definable as the basis of a BEAM operating system.(Bheemaiah, n.d.)

Small signal analysis of two port networks is incomplete in its role in BEAM circuit design, needing large signal analysis, and dynamical systems theory, of stochastic partial differential equations in computable field theory or embeddings in lattices of integers or complex numbers. Hence there is persistence, memory and computability in circuits, analogous to asymptotics and polynomial time definitions of field and lattice based computing. This generalization is in Lie Algebraic definitions of the lattices, in D4 in E8 species called Lie Computability.

Background.

Much of line detection circuitry stems from neurobiology research, which supports formal art element theory of the atomicity of line as form and structure in the neurophysiology of cognition, with support for the existence of circuits for line

segmentation and for shape by yet not understood mechanisms. While modern circuit theory is very distant from phenomenology in biological circuitry, a similar architecture is created as a non invasive animal model. Thus robotics serves as viable animal models for much of non-invasive 3R's research.

Speculation on cognition as more of preceptory mechanisms, rather than anatomical hard-wiring, is from hypothetical plastic reconfigurable circuitry in perception from lines. This circuitry is Tensor based and either discrete or continuous and represented in a tensor calculus on [NvH] and [NvT].

Topology.

A tensor definition of the circuit follows from many layers , [S] sensors, [NvL] the line detection layer, [NvH] the hexagon detection layer and [NvT] the triangle detection layer.

$(S^\circ) \leftrightarrow (NvL) \leftrightarrow$	1.0
$(NvL^\oplus) \leftrightarrow (NvH) \leftrightarrow$	1.1
$(NvL^\oplus) \leftrightarrow (NvT) \leftrightarrow$	1.2

1.0 represents multi sensor fusion, with line detection by a neuro-modulation system as a binary or a soliton/cw based coding as an event indicator.

The bus is represented by similar integrative nonlinear functions, between sets of line detectors of various configurations and Nv neurons for the emergent computation of semantic detection of polyhedra. The emergence is of concavity of the detection

of spatial coherence in six lines and three lines respectively.
Binary or CW/soliton neuro-modulation of the output, indicates categories of 'perception' as emergent A.I in the circuitry.

Discussion.

We have thus proven the generalized tensor formulation for a range of network topologies ranging from analog BEAM function driven architectures to deep learning networks, all of which are defined in a system of Lie Computability, in R^3 , (McLaughlin and Martin 1985) and higher spaces, bounded presently by E8 Representation theories.

Functionality of segmentation defines sensory perception in the tensor formulation of Nv Neuron topologies, for the definition of hard wired or plastic circuitry for perception in emergent A.I of polyhedral shapes. This synthetic construct may bear little resemblance to the emergence of shape perception, but current trends in 3D computer vision, lead to tessellation and triangulation approximationism, (Bheemaiah 2020) in the design of BEAM robotics as a model.

The circuits however project themselves as the autonomous thinking of the circuit world as a supplementary circuitry for iSense (Subaru Canada, Inc n.d.), and traffic sign detection in autopilot systems for pre-collision braking. This work forms advocacy, as **mandatory integration of pre collision automated braking systems and lane keeping in the legal framework.**

iSense is a word coined by the author to denote mandatory A.I technologies, for a transition to non-lethality, including 'eyesight' for automated braking, lane keeping, traffic sign compliance and automated seat belts.

Future Work.

As augmented reality merges triangulated 3D structures in the real world, the co-existence of SLAM based digital technologies, with analog BEAM like MFA I and MFA II networks may add to our models of the emergent A.I of shape from lines, in approximations and models, for perception models. Present segmentation algorithms in multi sensor fusion are very efficient in an object mirror and the creation of a supplementary BEAM based analog object mirror, adds to reliability engineering and remains a topic for future work.

References.

- Autiores, Varios, and International Workshop on Higher-Order Algebra, Logic and Term Rewriting. 1994. *Higher-Order Algebra, Logic, and Term Rewriting: First International Workshop, HOA '93, Amsterdam, The Netherlands, September 23 - 24, 1993. Selected Papers*. Springer Science & Business Media.
- Bheemaiah, Anil Kumar. n.d. "BEAM Autopilot."
<https://doi.org/10.35543/osf.io/st2xa>.
- Bheemaiah, Anil Kumar, Dr. 2020. "Approximationism as a New Art Form in Art Therapy." *PsyArXiv*.

- Dowek, Gilles, Jan Heering, Karl Meinke, and Bernhard Möller. 1996. *Higher-Order Algebra, Logic, and Term Rewriting: Second International Workshop, HOA '95, Paderborn, Germany, September 1995. Selected Papers*. Springer Science & Business Media.
- Hrynkiw, David, Mark W. Tilden, and Mark Tilden. 2002. *JunkBots, Bugbots, and Bots on Wheels: Building Simple Robots With BEAM Technology*. McGraw-Hill Osborne Media.
- Kirchner, Helene, and Wolfgang Wechler. 1990. *Algebraic and Logic Programming: Second International Conference, Nancy, France, October 1-3, 1990. Proceedings*. Springer Science & Business Media.
- Mark. n.d. "Road Signs - Know the Basic Shapes | Driversprep.com." Accessed June 14, 2020.
<https://driversprep.com/road-signs-know-the-basic-shapes/>.
- McLaughlin, Thomas, and Cylde Martin. 1985. "Computability and Non-Computability of Equivalence for Lie Structures That Are Pertinent to Control Theory." *1985 24th IEEE Conference on Decision and Control*.
<https://doi.org/10.1109/cdc.1985.268866>.
- "Nv Neuron by Bheemaiaha on DeviantArt." n.d. Accessed June 13, 2020.
<https://www.deviantart.com/bheemaiaha/art/Nv-Neuron-844695306>.
- Subaru Canada, Inc. n.d. "Subaru EyeSight - Subaru Technology - Subaru Canada." Accessed June 14, 2020.
<https://www.subaru.ca/WebPage.aspx?WebSiteID=282&WebPageID=18112>.