ANTICIPATION AND INFORMATION FEEDBACK. Mimicry and Latency Between Living Systems. Carola Dreidemie.

"There are thoughts we can anticipate, glimpsed in the distance along existing thought pathways."[1]

The presentation ties together fundamental concepts that affect the process of two ongoing software-art research-creation projects that visualize data from social insects's activity. Understanding the hive or the nest, and the machine, its computation and Ai artificial intelligence as living systems that feed, learn and evolve from feedback evaluation. Sustains the idea that living systems share a common behavior mechanism, that of a trial and response loop, for advancing purpose to the benefit of its immediate objectives, evolution, growth, survival and success.

Software art merges fine arts and technology, both histories and sometimes opposite methods of research and knowledge production. Current studies in Environmental Humanities, Post-humanism, Animal-Computer Interaction enrich the inquiry.

Why do things get in a muddle?[2] *...Daughter: Daddy, Why do things have outlines?*[3] *...What sort of order should we cling to so that when we get into a muddle we do not go mad?*[4]

The Shannon-Weaver model of systemic transmission or communication rendered around electronic engineering in 1948, explained communication in terms of five basic components: a source, a transmitter, a channel, a receiver, and a destination. The message appeared cleared of *all* meaning and removed from *any* physical materiality. A temporally directional signal processing through an ephemeral channel of transmission or medium towards the receiver or decoder. This mathematical theory, fundamentally generic, quickly expanded to impact studies in animal and human communication. Data could be anything.

But, "Data collection is inherently messy. In a muddy, leech-ridden, bloody-limbed way, but also in an imprecise, human way."[5]

The projects pursue the objectives of a-translating flight data into drawings and 3D computer renderings, or b-individuals and casts recognition and tracking, revealing complex motion dynamics, spatial and temporal relationships between individual and collective decisions. At the same time pursues a sensible analysis of the living systems at the crosshairs, while examining historically and critically the methods and devices that guide and/or limit our conceptual structures of measuring and seeing.

To achieve this, the work articulates studies of the evolution of the following:
DATA: a-Data as Information: Precision. Scale. Direction. Bias. Choice. Range. b-Coding: Analogue to digital translation. Language. Procedures. Memory. Storage. Loss.
TIME: Media temporality. Statistical approximation. Control. Averaging. Hierarchy-sizing. Scaling. Sampling. Periodic measuring. Errors. *The Time of Non-reality* [6] as Wiener called the periods of time between samplings.

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[1] Morton, T. Beginning After the End. In Dark Ecology. For a Logic of future Coexistence. Columbia University Press 2016.

[2] Bateson, G. Part I: Metalogues. Why Do Things Get in a Muddle? (1945) ..."*Why do things get in a state which Cathy calls not tidy? Do you see why I want to make that change?...Yes I think so -because if I have a special meaning for tidy, then some other people´s "tidies" will look like muddles to me-even if we do agree about most of what we call muddles-"* in Steps to an Ecology of Mind. The University of Chicago Press. Edition 2000.

[3] Ibid. (2) Bateson, G. Metalogue: Why Do Things Have Outlines?

[4] Ibid. (2) Bateson, G.

[5] Thorp, J. Living in Data. A Citizen´s Guide to a Better Information Future. MCD Farrar, Straus and Giroux. NY 2021

[6] Wiener, N. Cybernetics: or Control and Communication in the Animal and the Machine. The MIT Press, Cambridge, Massachusetts. Second edition. 1948

"Now that the concept of learning machines is applicable to those machines which we have made ourselves, it is also relevant to those living machines which we call animals, so that we have the possibility of throwing a new light on biological cybernetics."[7]

Information Feedback

The capacity to process and respond to information in self-corrective ways is a characteristic of living systems, from cells to forests to civilization.[8] This mechanism is evident all around us, in plant life, fungi, insect colonies, herds, even in markets and society.

Norbert Wiener, while developing a World War II project introduced the term **feedback** as well as **input** and **output**. These terms already existed in English, but were used to describe specificities of working mechanics related to a machine. After him, these terms adopted a macro level of meanings and began to be used in the humanities and in language to apply to any communication, including such as between individuals and animals. Furthermore, with Cybernetics, he conceptualized a new model that involved **power differentials**, a new framework for studying communication and control systems that could spread across multiple entities. "The first of this studies, and perhaps the defining case of cybernetics, was the subject of a WWII research project on which Wiener worked a system of a bomber, and an anti-aircraft gun, and a human operator of each."[9]

It is very interesting how he describes the structure of the system comparing it continuously to the human body: He further writes: "...This led us to another comparison between the nervous system and the computing machine, and led us, furthermore, to the idea that since the nervous system is not only a computing machine but a control machine, that we may make very general control machines, working on the successive switching basis and much more like the control machine part, the scheduling part of a computing machine, than we might otherwise have thought possible. In particular, it seemed to us a very hopeful thing to make an automatic feedback control apparatus in which the feedback itself was carried out, in large measure, by successive switching operation such as one finds either in nervous system or in the computing machine."[10] Psychologist Silvan Tomkins[11] describes an identical structure for the affects system: a project that needs the concept of multiple assemblies of varying degrees of independence, dependence, interdependence and control and transformation of one by another.

All systemic adjustment seems to require a degree of self awareness. This means that the individual or the machine needs to be in the capacity to know its state and to evaluate it within its temporal framework, and its sequential context, as well as to evaluate this state in relation to its aim. Recursiveness is a necessary feature of such process. Us humans, do this continuously a million times a day, but as we disentangle the steps of this procedure its complexity becomes scorching evident.

As German media theorist, Wolfgang Ernst, puts it: The question if technological artifacts - "non-human agencies" - have an implicit (physical and/or mathematical) sense of temporality immediately leads to the question whether machines are gifted with "**consciousness**". The philosopher of cybernetic logic, Gotthard Günther, ascribes to machines the possibility of consciousness – though not

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[7] Ibid. (6) Wiener.

[8] Bateson, C. Foreword by, 1999. In Bateson, G. Steps to an Ecology of Mind. The University of Chicago Press. Edition 2000.

[9] 04.[Introduction] Men, Machines, and the World About. The New Media Reader. Ed. By Noah Wardrip-Fruin and Nick Montfort, The MIT Press, 2003.

[10] Wiener, N. Men, Machines and the World About. Original Publication. Medicine and Science, 13-28, New York Academy of Medicine and Science. Ed. I. Galderston, New York: -international Universities Press, 1954. The New Media Reader. Ed. By Noah Wardrip-Fruin and Nick Montfort, The MIT Press, 2003.

[11] Tomkins, S. Affect, Imagery, Consciousness, AIC, 1991 in Shame in the Cybernetic Fold: Reading Silvan Tomkins, Kosofsky Sedgwick, E., Frank, A. Touching Feeling. Affect, Pedagogy, Performativity, Duke University Press, 2003.

self-consciousness (a quality reserved for human intelligence)[12]. Consciousness is no material quality, but "a metaphysical instance of existence which can smoothly be translated from one existential 'aggregate state' into another." This almost literally rephrases Turing's notion of the machinist "states". Can machines be conscious of their temporal state? According to Turing, the computing machinery is at any discrete temporal moment "conscious" of its state as being read from symbols inscribed on the intermediary recording tape. Thus man can invest the "countable", thus "clocking" parts of his own consciousness into the machine.[13]

Redundancy and Patterning

Reconstruction of patterns of thought, in *Mind and Nature: A Necessary Unity* (1979) by Gregory Bateson. Bateson´s *Ecology of Mind* is described as a system of control that he finds in nature and in the universe. Holistically looking-, he makes particular emphasis in discerning **patterns**: ¨the ecology of mind is an ecology of pattern." Further, he specifies a particular danger to not practicing a holistic analysis of this sort "...a science which limits itself to counting and weighing these embodiments is likely to arrive at very distorted understanding."[14] Bateson traced destructive human action as a direct consequence of inappropriate descriptions, "...even though **knowledge** and belief themselves involve deep chasms of unknowing."[15] Last, there is a special form of knowing which is usually regarded as adaptation rather than information.[16]

Structure. Symmetry. Segmentation. Serial Repetition. Serial Difference. Patterns.

Taking yet another giant leap, Bateson promotes the same control system embedded structure onto systems that involve multiple separate living individuals, -such as a hive-, for example. He is paraphrased stating: … "It becomes clear that mind is composed of multiple material parts, the arrangements of which allow for process and pattern… A mind can include nonliving elements as well as multiple organisms, may function for brief as well as extended periods, is not necessarily defined by a boundary such as an envelope of skin, and consciousness, if present al all, is always only partial." [17] Obviously this last remark opens ground for another discussion.

Bateson´s essential minimal characteristics of a system (of Mind): (I would like to think of it besides a computer system.)
(1) The system shall operate with an upon differences.
(2) The system shall consist of closed loops or networks of pathways along which differences and transforms of differences shall be transmitted.
(3) Many events withing a system shall be energized by the respondent part rather than by impact from the triggering part.
(4)The system shall show self-correctiveness in the direction of homeostasis and/or in the direction of runaway.

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[12] Gotthard Günther, Das Bewutsein der Maschinen. Eine Metaphysik der Kybernetik, Krefeld / Baden-Baden (Agis), 2nd ed. 1963, supplement IV, 179-203.

[13] Ernst, Wolfgang "Else. Loop. Forever. The Untimeliness of Media. Extended draft of the paper given at the conference Il Senso della Fine , Università degli Studi di Urbino, Centro Internazionale di Semiotica e Linguistica, 10-12 September, 2009.

[14] Ibid (8) Bateson, G.

[15] Ibid.(8) Bateson, G.

[16] "*A shark is beautifully shaped for locomotion in water but the genome of the shark surely does not contain direct information about hydrodynamics… Similarly, a migratory bird perhaps does not know the way to its destination ...but the bird might contain the complementary instructions necessary to to cause it to fly right*." Levels and Logical Types, Part II: Form and Pattern in Anthropology. Steps to and Ecology of Mind. Bateson, G. The University of Chicago Press. Edition 2000.

[17] Ibid (16) Bateson, G.

And finally I need to add that for (a species) longterm survival, Bateson underlies the importance of *diversity* in maintaining *flexibility* (and *resilience*), in the search for basic continuities that support *adaptation*, including *learning how to learn from change* and *cultural disparity*. Flexibility that matches the environment to create an ongoing complex system that is open-ended. Bateson´s Mental Systems as including more than single organisms makes him propose that the unit of survival is always *organism plus environment.*

Computers, as well as our firsts instruments for the acquisition of empirical knowledge, our mechanical apparatuses of science, most often than not, mimic our organs of viewing, and perceiving. The French philosopher René Descartes in *La Dioptrique* (1637)[18] demonstrates de functioning of a human eye following a gruesome experiment of cutting an eyeball to evidence this equivalence in structure and operation to the mechanical device known as the camera obscura. Descartes´s model of the human eye was later embodied in yet another optical apparatus known as *oeil artificial* (Artificial eye) made of metal and glass, again exemplifying looping and redundancy in knowledge creation.

It does not seem possible to remove ourselves from the limitations imposed by our bodies when we think and design or create machines. In "The Porcupine and the Car," video artist Bill Viola points at the limitations of our senses referencing philosopher Henri Bergson in such a way that he presents the senses as 'limiters' of energy and of the amount of information reaching us at every instance. He points at the camera as embodying a point of view that Viola names 'point of consciousness', a perceptual place in a space. States: "*One of the most interesting aspects of recording media is how they tell us so much about the way we perceive the world.*"[19]

Artificial intelligence feeds from this feedback mechanism, finding a response and adjusting its aim, and repeat again, in appearance identical still to that of nature and life forms as we understand them.

Anticipation

In *Men, Machines and the World About*, Wiener further writes: "It became evident by the end of the First World War, and certainly by the period between the two, that the essence of the problem was to do all the computation in advance and embody it in instruments which could pick up the observations of the plane and fuse them in the proper way to get the necessary result to aim the gun and to aim it, not at the plane, but sufficiently ahead of the plane, so that the shell and the plane would arrive at the same time as induction. That let to some very interesting mathematical theories."[20]

Wolfgang Ernst, in "Else Loop Forever. The Un-timelessness of Media"[21] introduces an interesting term: Represensing. A term that couples a representation with something *sensed*. This term 'sense' stands in-between knowing and anticipating, and involves the senses in accordance with what is acknowledged and known, and with what is expected or projected.

Represensing of the qualities mentioned, is particularly interesting for the study on bee hive and wasps behavior as it appears evident that it is an acting condition present in living systems dynamics. In the dictionary, Represensing is described as: "The act of having a sense of representing or representation of a hood or posse without prior knowledge or affirmation." An action of representation disposed of any kind of assurance or of certainty of the immediate future, lacking the information of a 'read future'. An action taken as a gamble, as a leap of faith.

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[18] Descartes, René. 1956. La diaptrique. In Oeuvres de Descartes, vol 6, Discours de la méthode et essais. Ed. Charles Adam and Paul Tannery. Paris: Library Philosophic J. Vrin. Pp.114-29. In Stafford, B.M. and Terpak, F., Devices of Wonder. From the World in a Box to Images on a Screen. Getty Research Institute, Los Angeles, 2001.

[19] Viola, B. Reasons for Knocking at an Empty House: Writings 1973-1994, 1995.

[20] Ibid (10) Wiener.

[21] Ibid (13) Ernst.

For computation, this is handled through statistical approximation, averaging, hierarchy-sizing, scaling up. Insects have a curious way of approaching this mechanism of information feedback. It would be naive of us to assert that insects at a hive or nest project their flights or movements without the confidence of understanding complex movement dynamics in their own knowing ways. It is evident that their mastery of anticipation is part of their beings otherwise they would collapse against each other. As Bateson ventures to explain, it may already be present in a lower level gene of the individuals. In this matter, we humans have fallen very behind.
Things alive seem to us unpredictable. We still use words like instinct as blackbox-words.

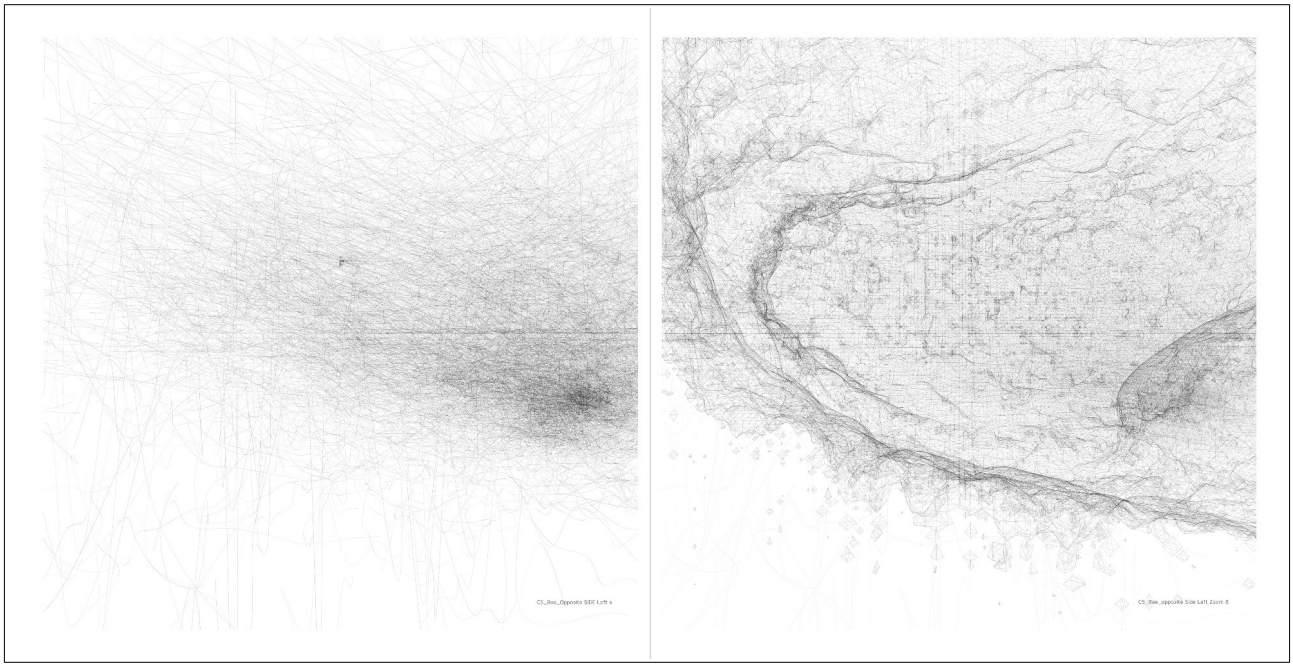
Latency
We could discuss the differences between analog and digital communication, most commonly specified as digital being analytical and two-valued and analog, dialectical and many-valued. Digital distinctions introduce gaps into continuums. Or simply describe latency as signifying a delay or a lag. But, I prefer to think of latency as the information that is not yet ordered, measured or classified. An unknown. Those intervals of time or space or matter in between samplings that anything organic holds. Wiener´s precious time of non reality. I share with Bateson the belief that, "advances in scientific thought come from a combination of loose and strict thinking, and that this combination is the most precious tool of science."[22]

Artist have known for a long time that the most interesting connections in things involve areas of low, or ambiguous, information, so-called gaps in recognition.[23]

IMAGES

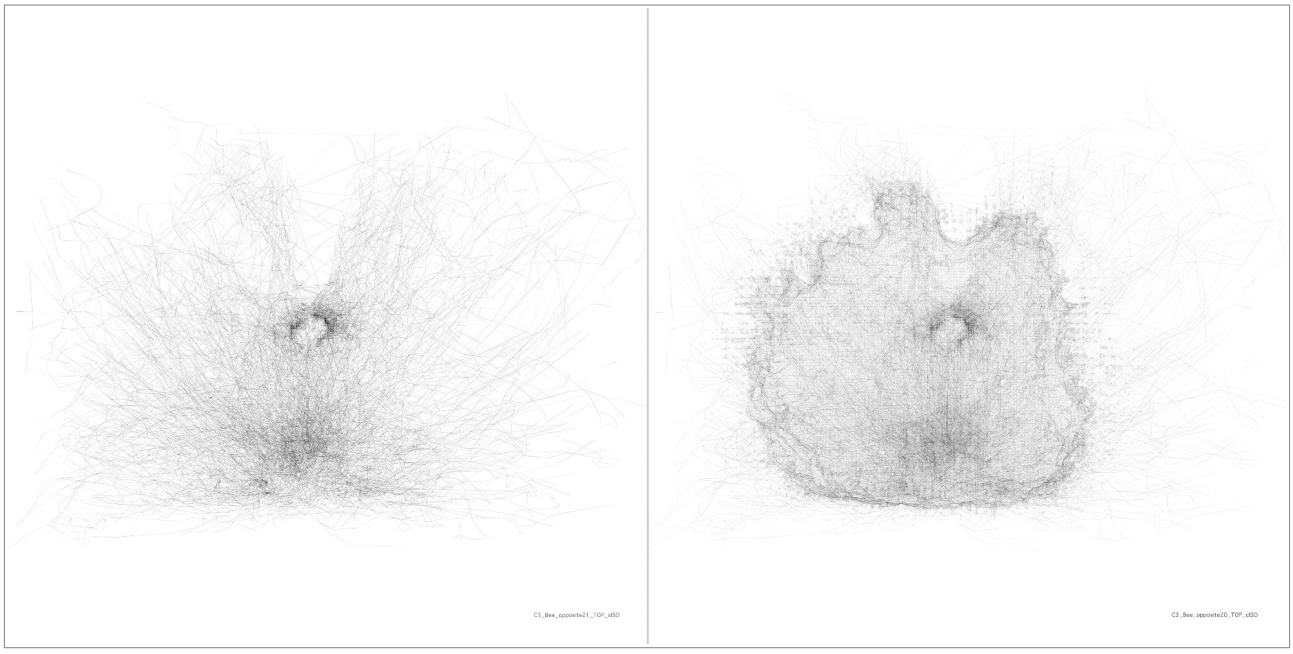
Project One: Trajectoires éphémères (Bee flight trackings):
Drawings 100cmx100cm printed on Hahnemüle Photo Rag paper 308g.

Diptych_two_C5_Bee_oppositeSideLeft_9_8 Carola Dreidemie.

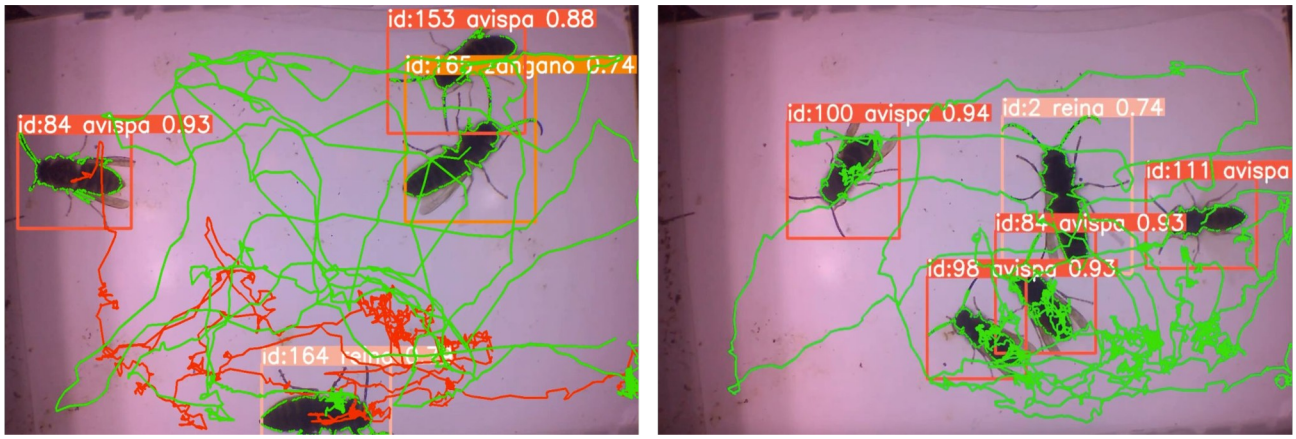


[22] Bateson, G. Experiments in Thinking About Observed Ethnological Material. Ibid. (2)
[23] Viola, B. Reasons for Knocking at an Empty House: Writings 1973-1994, 1995.

Diptych_one_C3_Bee_opposite21_20_TOP Carola Dreidemie.



Project Two: Wasp (yellow jacket monitoring station) automatic cast detection training and validation using deep learning:[24]



Example of wasp detection and tracking after training the YOLOv8 model for caste-detection. For each 15 min video, each individual was assigned a trajectory (ByteTrack tracking algorithm) with a unique identification number (id), and a caste (avispa = worker, zangano = drone and reina = gyne) associated with a probability (0.00–1.00, e.g., 0.93 for id: 84) of belonging to that particular caste.

KEYWORDS: LIVING SYSTEMS, DATA, INFORMATION FEEDBACK, VISUALIZATION, DEEP LEARNING.

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[24] Martínez, A.S., Dreidemie, C., Inchaurza, F., Cucurull, A., Basti, M. & Masciocchi, M. (2024) Advancing social insect research through the development of an automated yellowjacket nest activity monitoring station using deep learning. Agricultural and Forest Entomology,1–13. Available from: https://doi.org/10.1111/afe.12638

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