Time and Terraforming: Farming with Recursive Algorithms

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IS71076B: Computational Arts-Based Research and Theory (2020-21)

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In *An Ecology of Time,* Stengers argues for concerns over truth (Stengers, 2013). She cites the example of an ecological study; ecologists are not concerned with whether the wolf or the sheep is *right* only how their *concerns* produce behavioral patterns. Stengers believes inter-disciplinary study is plagued by an obsession with truth. Here we articulate a metaphysics of time which we use to analyze cybernetic systems. These ideas are applied to intercropping systems to diagram temporal behaviors that compromise algorithmic attempts at agricultural optimization.

1. A Fake Metaphysics of Time

Global scale computation makes humans increasingly aware of a tangled knot of overlapping systems. At the scale of assemblage, humans have a growing ability to perceive and affect changes on systems operating on 'non-human' time scales. This obsolesces lay philosophies of time. Our concern is to outline a more useful metaphysics of time.

We start with Einstein and Bergson. Bergson argued that Einstein's theory of relativity was a theory of the behavior of clocks with little relevance to metaphysics of time (Bergson and Jacobson, 1999). Unfortunately, Bergson doesn't outline a definition, believing any conceptualization of time distorts the flow of phenomena. We need a scalpel to cut into the world. Building on Bergson's ideas in a structured way we turn to Husserl. For Husserl time consists of sequential simultaneities, composed of a protention (virtual anticipation), a retention (virtual memory) and a perception (real perceived via phenomena) (Husserl, 1964).

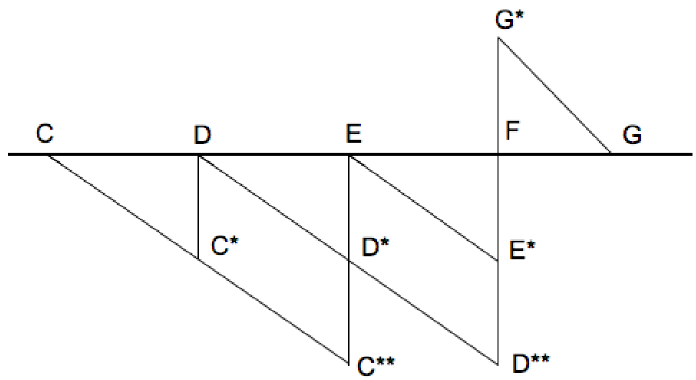


Figure 1. a diagram of Husserl's conception of time.

Each system we ascribe *duration* to, we imagine carried along this timeline (this is Bergson's *leap of intuition*). This should not be restricted to "humans". This intuitive extension is like that made by Yuk Hui in extending Heidegger's concept of *Dasein* to technology (Hui, 2019).

2. Time and Cybernetics

Armed with a model of time, we need a method of modelling complex systems. Cybernetics is a method of analysis focused on causal loops. Following cybernetic principles, systems are understood in terms of sensors, controllers and environment (Wiener, Hill and Mitter, 2019). Sensors detect changes in the environment, relaying them to the controller, which performs operations.

Using the example of a processing plant as a real time system, a processing plant contains a variety of sensors, actuators and measured variables to perform operations and produce an output which they all respond to. These components act (sense, produce a change) within their respective temporal limits. Components have homeostatic loops, but have clearly defined boundaries (diameter of pipe, volume of storage tank). What would happen if a pump suddenly decreased its rotations, reducing the flow/pressure in the system? How would other components respond? Will they modify their temporal intervals? The system will fail to produce the defined output without a way to measure and respond to changes in temporal interval of components.

In a dynamic cybernetic world where agents recursively reproduce themselves with different experiences of non-linear time, how can agents coordinate themselves relative to other agents? Can manipulating feedback loops of a system alter agents' experiences of time, and what effect does this have on wider systems?

3. Time on the Ground

Intercropping is a crucible to test these ideas. Technological developments have been the driving force in most farming practices (Lewis, 1998). Hyper-febrile chemical sensors move the system from individual sensing capacities into the territory of the assemblage. This accompanies the deployment of agricultural algorithms with vast retentions and perceptual capabilities, operating at break-neck speeds. Within a capitalist system imposing a Darwinian drive towards optimization, individuals or community units cannot compete with distributed techno-capital assemblages. It remains to be seen whether techno-capital engineering can escape the temporality of the extant ecosystem. Intercropping is fertile soil to explore these ideas, where technology, societal structures, plants, pollinators and the climate interact, each a complex system with its own rate of passage through time.

Our artefact is a simulation of an intercropping system. It takes four agents (soybean, sugarcane, pollinator and plant-destroyer), defines their internal structures and interactions with their environment. Underneath these agents the simulation stretches the control mechanisms of capital and an alien fungus. Both symbiotes that are manifested in the environment through altered behavioral patterns of their infected partners. By repeatedly running the simulation and interpreting results we slowly build an ecological bestiary, a plan of the coiling and uncoiling of time based on patterns of growth, death, reproduction and survival of intercropped agents.

The simulation operates on Husserl's time. Each frame a simultaneity, the move between frames a sequential updating of information in the system. The simulation, like many cybernetic systems, has rigidly limited protentions and precision-cut sequential retentions. The simultaneity and subsequent retention constitute the 'inside' of each agent. The protention is a range of values that the system stands ready to accept. The unfolding of time is characterized by periodic measurement of values generated by processes external to each system.

Each agent is a system in miniature (the system fractalizes), and carries in its structure blind spots. These blind spots often involve temporal asymmetries. The artefact diagrams methods of bottoming out a system that proceeds from simultaneity to simultaneity via a recursive movement.

1. Recursive Acceleration: reducing the temporal interval via a positive feedback process enables run-away processes to proliferate. As the object reaches the upper frame limit of the simulation the simulation loses utility and drifts free of reality. The agent that recursively increases its speed must survive long enough to reach escape velocity.
2. Recursive Fractalization: at each recursive step the agent generates new objects for the system to track. As the scope of the real in the simultaneity widens eventually the algorithm can no longer bear the weight.

These methods of disrupting a cybernetic control are talismans, reminding us to maintain open relationships with systems, to play with them. Cybernetic systems, by definition, interact with their environments. The components of systems continually form relationships with the outside, exposing themselves to potential run-away effects. As Sadie Plant says "Invulnerability would be homeostasis, an absolute and fatal stability" (Plant, 1998).

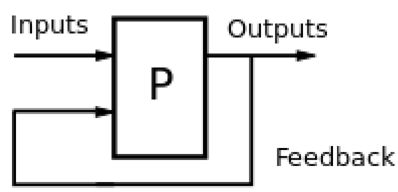
Glossary

System - 'A set of elements or parts that is coherently organized and interconnected in a pattern or structure that produces a characteristic set of behaviours.. '(Meadows, 2008)

Real-Time System - A real-time system operates with a time constraint, where the time that the output produced is significant. In other words, producing the output at some other time than the required time may be meaningless.

System Theory - "A framework for conceptualizing the self-regulatory and self-organizing processes governing inputs to systems, the transformations of inputs into outputs and feedback loops"

Feedback Loops - "The mechanism (rule or information flow or signal) that allows a change in a stock to affect a flow into or out of that same stock" (Meadows, 2008)



Recursivity - "A recursive function (in Computer Science) simply means a function that calls itself until a halting state is reached." (Hui, 2017)

"Programming makes use of routines called 'procedures' which may need to execute other procedures. In self-referential programming, the procedure calls itself." (Eglash, 1999)

```
void RecursiveFunction(State state){
    ---series of perceived events/procedures---
    RecursiveFunction(state);
}
```

Temporal Interval – The clock time between an agent's simultaneities.

References

Bergson, H., & Jacobson, L. (1999). *Duration and Simultaneity: Bergson and the Einsteinian Universe* (Philosophy of Science) (2nd ed.). Clinamen Press Ltd.

Eglash, R. (1999). *African Fractals*. New Brunswick: Rutgers University Press.

Hui, Y. (2017). Preface: The time of execution. *Executing Practices*.

Hui, Y. (2019). *Recursivity and Contingency* (Media Philosophy). Rowman & Littlefield Publishers.

Husserl, E. (1964). *The Phenomenology of Internal Time-Consciousness*. Indiana University Press.

Lewis, T. (1998). Evolution of farm management information systems. *Computers and Electronics in Agriculture*, 19(3), 233–248. https://doi.org/10.1016/s0168-1699(97)00040-9

Meadows, D. H., & Wright, D. (2008). *Thinking in Systems: A Primer*. Chelsea Green Publishing.

Plant, S. (1998). *Zeros + ones*. London: Fourth Estate.

Simondon, G. (2009). Technical mentality. *Parrhesia*, 7(1), 17–27. http://blogs.bbk.ac.uk/artsresearch/files/2016/09/gilbert-simondon-technical-mentality.pdf

Stengers, I. (2013). Introductory Notes on an Ecology of Practices. *Cultural Studies Review*, 11(1), 183–196. https://doi.org/10.5130/csr.v11i1.3459

Wiener, N., Hill, D., & Mitter, S. (2019). *Cybernetics or Control and Communication in the Animal and the Machine*, Reissue of the 1961 second edition (The MIT Press) (Reprint ed.). The MIT Press.