30 Years of Computational Autopoiesis: A Review

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From Autopoiesis to Neurophenomenology: A Tribute to
Francisco Varela
(FoilTeX Presentation)

Preamble . . .

. . . I particularly remember a discussion over dinner one evening during the third ECAL (Grenada, Spain, in 1995), where he dazzled me not only with his ability to maintain three simultaneous conversations with different people, but to do so in three (or more?) different languages, switching continuously between them!

Outline

- Origins
- The Minimal Model
- Elaboration (I)
- Diversification
- Conjecture and Refutation
- Lessons for Methodology?
- Elaboration (II)
  - Individuation
  - Direct Descendants
  - Lattice Artificial Chemistry
- Related Developments
- Conclusion

Origins

. . .   the simulation rapidly provided the results our
intuition had led us to expect: the spontaneous emergence
in this artificial bi-dimensional world of units which self-
distinguished by means of the formation of a 'membrane',
and which showed a capacity of self-repair.

The Minimal Model
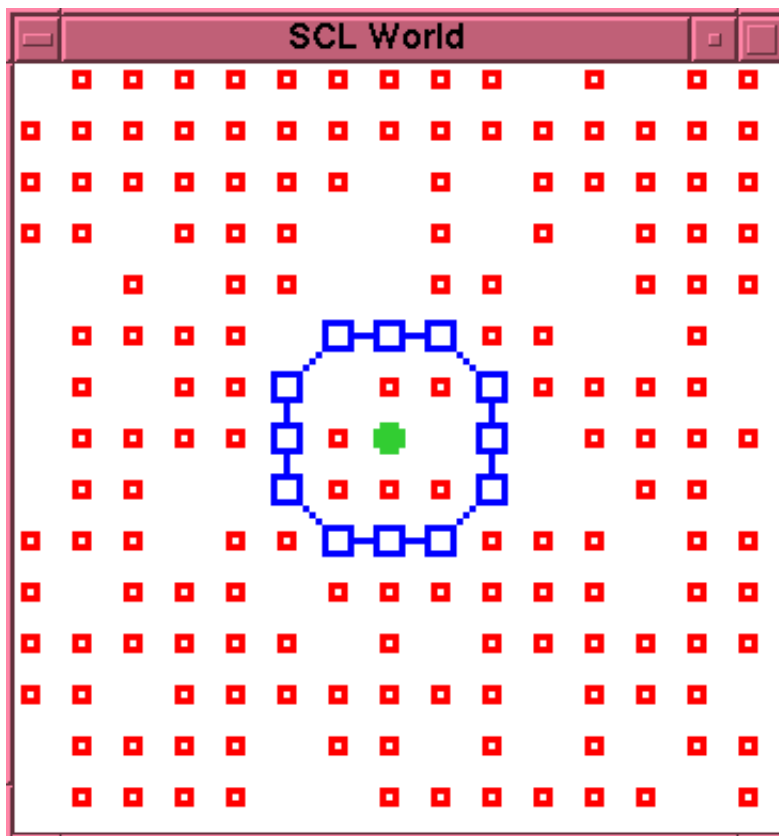
(Aside. . .)

In conclusion, it is evident that the system A, B, M could be extended to a three dimensional system. [However] it is judged that the implementation of a three dimensional model would involve difficulties which are not worth overcoming at this stage, as the extension of the proposed model to three dimensions would not involve any conceptual modifications. [Handwritten] In the three dimensional model the motion of the @ and M- particles would take place in a three dimensional space. The chains of M* [particles] would now become surfaces, with edges composed of M+ [particles] capable of "capturing" new M- [particles] allowing the surface to grow and close, enclosing the @ particle. The volume inside this "spherical-membrane" would become populated by M- particles, ready to repair the "membrane" at the points where it is destroyed [disrupted?] by disintegration of the M* particles.
    –Varela & Maturana *Protobio* 1971 (?)

Elaboration (I)

- Zeleny: APL-Autopoiesis
- Growth, Morphology, Oscillation
- Self-reproduction
- BUT:
  - Non-local interaction?
  - Non-random motion?
  - Time dependent dynamics?
- *Show me the source code...*

Diversification

- Maturana & Varela . . .
- Milan Zeleny collections
- Pier Luigi Luisi: Wet Autopoiesis
- Gail Raney Fleischaker: Simulation or Realisation?

Conjecture and Refutation

- von Neumann and evolutionary automata
- Artificial Darwinism - The Very Idea!
- Just unite von Neumann and Varela et. al. models. . .

But. . .

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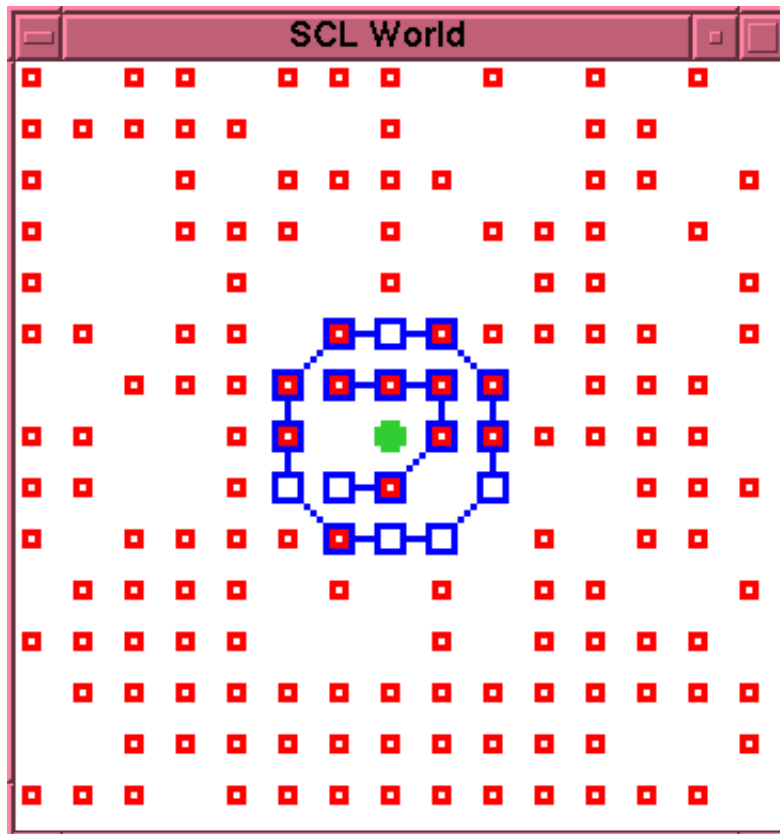
Protobio **Re-discovered**

- FORTRAN IV code (!?)
- Contemporary discursive description
- Reverse engineering . . .
- . . . leads to *chain-based* bond inhibition

So?

. . . The non-computability of Autopoietic systems, as advanced here, apparently collides with the simulation results involving tessellation automatas. But new versions of this simulation show that the original report of computational autopoiesis was flawed, as it used a non-documented feature involving chain-based bond inhibition. Thus the closure exhibited by tessellation automatas is not a consequence of the "network" of simulated processes, but rather an artifact of coding procedures.

- Juan Carlos Letelier et. al. (J. Theo. Bio. 2003)

Lessons for Methodology?

- APL-autopoiesis: may never know.
- Protobio: finally rediscovered.
- *Show me the source code...*

Elaboration (II)

- Individuation:
  - Colectively Autocatalyic Set + Boundary
  - Heuristic test . . . ...
  - *Alcheny?*
  - α-*Universes?*
  - *Tierra?*

Elaboration (II)

- Direct Descendants
  - Breyer et. al.: Flexible membrane, growth, SR?
  - McMullin & Groß(Chu): Flexible membrane, growth, SR?

Elaboration (II)

- Lattice Artificial Chemistry
  - Ono & Ikegami
  - Coarse Graining
  - Growth, SR
  - Selection (!?)

Related Developments

- Ganti: Chemoton
- *Alcheny?*
- α-*Universes?*
- *Tierra?*
- Formalisation: Rosen?

Varela the Scientist . . .

    Francisco Varela was, of course, a brilliant and original scientist. . . .

. . . Varela the Man

. . . But my enduring memory is of Francisco the man: his enthusiasm, his infectious good humour, his idealism, and his sheer appetite for life. He is sorely missed.

Related Online Resources

- Full Paper:
  - `http://www.eeng.dcu.ie./~alife/bmcm-alj-2004/`
- DCU Alife Laboratory:
  - `http://www.eeng.dcu.ie/~alife/`
- Research Institute for Networks and Communications Engineering (RINCE):
  - `http://www.rince.ie/`

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