— vordenker-archive —

Rudolf Kaehr
(1942-2016)

Title

Interactions with Claviatures
Short of 'Claviatures for morphic and indicational Sound and Graphic CAs'

Archive-Number / Categories

3_46 / 12, K09, K11

Publication Date

2015

Keywords / Topics

Morphograms, Celluilar Automata, Semiotics

Disciplines

Computer Science, Artificial Intelligence and Robotics, Logic and Foundations of Mathematics, Cybernetics, Theory of Science

Abstract

Claviatures gives a glimpse into the usefulness of the sub-rule approach for all kind of cellular automata. The merits of the sub-rule approach becomes evident for highly complex automata where it is practically not achievable to manipulate all single rules of the automaton explicitly.
With the sub-rule approach the single rule configuration that are defining an actual machine are constructed by the chosen keys of the claviature. Like for musical keyboards the melodies are composed by the chose of the keys and are not looked up from a list of stored melodies.
Even for a quite simple example of a CA based on the indicational rules *indRCI*, the complexity is not to handle by classical approaches. The sub-rule approach offers a *claviature* of the rule set so that all individual possibilities of the rule space of size 4^20=1’099’511’627’776 are manually accessible. The complexity of claviatures remains in a finite range of small sets of rules measured by the sum of the Stirling Numbers of the Second Kind.
Hence the rule space of *ruleDM* of the first example of the *Claviatures* is defined by the 15 morphograms distributed over 15 places generating the combination of 2x3x3x3x4 = 216 single morphogrammatic compounds of ruleDM[{k,l,m,n,o}] with k={1,6}, l={2,7,11}, m={3,8,12}, n={4,9,13} and o={5,10,14,15}. Therefore the claviature of *ruleDM* with its 15 keys defines all 216 different potential realizations of the automaton *morphoDM.* Because the number of functions for this morphoCA is small and manageable there is no barrier to define the functions explicitly.
But the rule space for *ruleDCKV* of is 2x3^7x4^6 x 5 = 89’579’520. There is certainly no realistic chance to define this amount of rules and to handle it explicitly. The case for the indicational automaton indRCI with its ruleRCI[{a,b,c,d,e, f,g,h,i, j,k,l,m,n,o,p,q,r,s,t}], where all components have 4 mutually excluding different indicational rules, the rule space is intriguingly less accessible without the sub-rule approach proposed in this paper.
The 20 positions of the automaton *indRCI* are defining 4^20=1’099’511’627’776 different potential realizations of the indicational rule space of *indRCI*. In contrast, the rule space of ECA is 2^8 = 256.

Citation Information / How to cite

Rudolf Kaehr: "Interactions with Claviatures", www.vordenker.de (Sommer Edition, 2017) J. Paul (Ed.),
http://www.vordenker.de/rk/rk_Interactions-with-Claviatures_2015.pdf

Categories of the RK-Archive

K01 Gotthard Günther Studies
K02 Scientific Essays
K03 Polycontexturality – Second-Order-Cybernetics
K04 Diamond Theory
K05 Interactivity
K06 Diamond Strategies
K07 Contextural Programming Paradigm
K08 Formal Systems in Polycontextural Constellations
K09 Morphogrammatics
K10 The Chinese Challenge or A Challenge for China
K11 Memristics Memristors Computation
K12 Cellular Automata
K13 RK and friends

http://memristors.memristics.com/Interaction-Claviatures/Interactions%20with%20Claviatures.html

Interactions with Claviatures

Short of ‘Claviatures for morphic and indicational Sound and Graphic CAs’

Dr. phil Rudolf Kaehr

ISSN 2041-4358
(work in progress, v. 0.5.5 July, May 2015)

Conceptual background

Claviatures gives a glimpse into the usefulness of the sub-rule approach for all kind of cellular automata. The merits of the sub-rule approach becomes evident for highly complex automata where it is practically not achievable to manipulate all single rules of the automaton explicitly.

With the sub-rule approach the single rule configuration that are defining an actual machine are constructed by the chosen keys of the claviature. Like for musical keyboards the melodies are composed by the chose of the keys and are not looked up from a list of stored melodies.

Even for a quite simple example of a CA based on the indicational rules *indRCI*, the complexity is not to handle by classical approaches. The sub-rule approach offers a *claviature* of the rule set so that all individual possibilities of the rule space of size 4^20=1’099’511’627’776 are manually accessible.

The complexity of claviatures remains in a finite range of small sets of rules measured by the sum of the Stirling Numbers of the Second Kind.

Hence the rule space of *ruleDM* of the first example of the *Claviatures* is defined by the 15 morphograms distributed over 15 places generating the combination of 2x3x3x3x4 = 216 single morphogrammatic compounds of ruleDM[{k,l,m,n,o}] with k={1,6}, l={2,7,11}, m={3,8,12}, n={4,9,13} and o={5,10,14,15}.

Therefore the claviature of *ruleDM* with its 15 keys defines all 216 different potential realizations of the automaton *morphoDM.* Because the number of functions for this morphoCA is small and manageable there is no barrier to define the functions explicitly.
But the rule space for *ruleDCKV* of $\text{morphoCA}^{(5,5)}$ is 2x3^7x4^6 x 5 = 89’579’520. There is certainly no realistic chance to define this amount of rules and to handle it explicitly.

The case for the indicational automaton indRCI with its ruleRCI[{a,b,c,d,e, f,g,h,i, j,k,l,m,n,o,p,q,r,s,t}], where all components have 4 mutually excluding different indicational rules, the rule space is intriguingly less accessible without the sub-rule approach proposed in this paper.

The 20 positions of the automaton *indRCI* are defining 4^20=1’099’511’627’776 different potential realizations of the indicational rule space of *indRCI*. In contrast, the rule space of ECA is 2^8 = 256.

Rule space table

Rule space table

DCKV	89 579 520	2 × 3^7 × 4^6 × 5
DM	216	2 × 3^3 × 4
DMN	486	2 × 3^5
CIR	59 049	3^10
RCI	1 099 511 627 776	3^20

The current presentation of Claviatures for 1D automata is not restricting its application to 1D CAs, all higher order cellular automata of arbitrary dimensions are incuded to the application of claviatures.

Epistemologically, there is a paradigm change involved which turns the definition of classical CAs from an '*algebraic*' to a '*co-algebraic*' understanding of generalized CAs.

The co-algebraic approach emphasizes the '*stream*' of computational events, and configurations are selected out of the stream by selectors like the proposed claviatures. Therefore there is no need to construct all the possible constellations step by step by CA rules.

Instead of developing *reduction* techniques to reduce the complexity of CAs, the claviatures approach plays on a meta-level with CAs that are accessible by selection. This leads to the well known automata theoretic concept of *experiments with automata*.

Algebraic structures have to be constructed, co-algebraic structurations have to be selected by interaction.

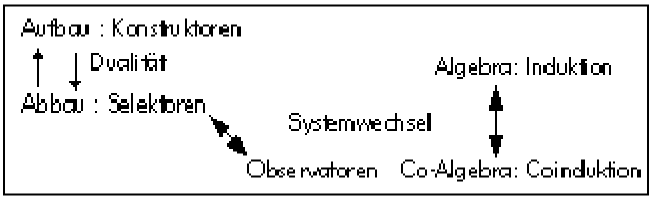
There is not just a simple duality between algebras and co-algebras in respect of constructors and destructors but also a not well recognized *asymmetry* between the pair "constructors/destructors" and the new deconstructors. A chiastic system change happens from the *selectors* of the destruction to the *observators* of co-algebras under the interaction of experiments.

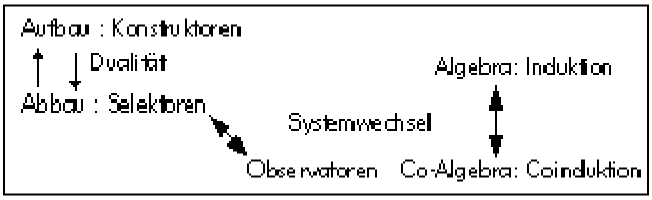
Duality of algebras and co-algebras

Algebra	Ko-Algebra
induction	co-induction
initial	final object
constructor	destructor
total	partial functions
algebra	coalgebra
visible	hidden
structure	behavior
well founded	non well founded sets
Turing Machine	Persistent TM
Horn clauses	liveness axioms

Algebra	Ko-Algebra
induction	co-induction
initial	final object
constructor	destructor
total	partial functions
algebra	coalgebra
visible	hidden
structure	behavior
well founded	non well founded sets
Turing Machine	Persistent TM
Horn clauses	liveness axioms

Asymmetric shift from internal to external descriptions of selectors and observators





The organon of the claviatures

The claviature approach is exemplified with the morphogrammatic CAs for *ruleDM*, *ruleDMN*, *ruleDMNP and ruleDCKV*. Also for the indicational CAs for *ruleCI*, *ruleCIR* and *ruleRCI*. All are applied to the categories of graphics, sound, transition graphs and fixedpoint determination. The case for ECA is exemplified for all categories too.

The method of sub-rules for CAs is an *abstraction* and *parametrization* of the components of the rule schemes that allows a micro-analysis of the CAs. The CA sub-rule manipulator manages explicitly all CA rules of a 1D CA. The sub-rule manipulators enables a *micro-analysis* of the behavior of all CA rules. Comparisons of the behavior of rules, especially of groups, families and clusters of sub-rules, are part of a new kind of micro-analysis based comparatistics.

Further reading

Peter Wegner, *Why Interaction is more Powerful than Algorithms, 1997*

http://wit.tuwien.ac.at/events/wegner/cacm_may97_p80-wegner.pdf

Dina Goldin, Peter Wegner, *The Interactive Nature of Computing: Refuting the Strong Church-Turing Thesis*

http://cs.brown.edu/people/pw/strong-cct.pdf

Rudolf Kaehr, STRUKTURATIONEN DER INTERAKTIVITÄT,
Skizze eines Gewebes rechnender Räume in denkender Leere (2004)

http://www.thinkartlab.com/pkl/media/SKIZZE-0.9.5-medium.pdf

http://www.thinkartlab.com/pkl/lola/Interactivity.pdf

[[interactive view with .html and .cdf]]

Initialization

Requisites

Procedures morphoDCKV

Rules

Graphics

Morphogram: ruleDM

Morphogram: Random ruleDM

Morphogram: ruleDMN

Morphogram: ruleDMN, Random

Morphogram: ruleMNP

Morphogram: Random ruleDMNP

Morphogram: ruleDCKV

Morphogram: ruleDCKV, Random

Indication: ruleCI

Indication: ruleCI random

Indication: ruleCIR

Indication: ruleCIR Random

Indication: ruleRCI

Indication: Random ruleRCI

ECA

ECA Random

Sound

ECA

Morphogram: ruleDM

Morphogram: ruleDMN

Morphogram: ruleMNP

Morphogram: ruleDCKV

Indication: ruleCIR

Indication: ruleRCI

Structures: Transition Graphs

ECA

Morphograms: ruleDM

Morphograms: ruleDMN

Morphograms: ruleDCKV

Indication: ruleCIR

Indication: ruleRCI

FixedPoints

FixedPoints: ECA

Number of events, rule number and sub - rules

FixedPoints: ruleM

Structure of self - modifications for the morphogrammatic calculus morphoCA DM

FixedPoints: ruleMN

Structure of self - modifications for the morphogrammatic calculus morphoCA DMN

FixedPoints: ruleCIR

FixedPoints: ruleDCKV