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The Logical Object Identification Schemes

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Abstract: The stationary logical object is understood to be its identification with an Adequate finite-automation model among set of finite automation. Where two completely different aims are being pursued (Object logical structural model construction and device logical control) serious contradictions might arise. With help of an Adequate model received, one can try both to construct appropriate structural model of the Computing Unit (CU) and considering the object as a control object to control it. A digital signal processor is used for the development of CO which represents the logical object and its structural model under construction. The principle distinction between finite-automation identification for developing of the Logical structure object model and for logical control of the technological device is shown in this study. The object self-control can be reached by the conversion of the potential dynamic technological object to the guided dynamic object.

Key words: Identification, logic object, modeling, automation, control, Jordan

INTRODUCTION

The new Logical-mathematical method for proving common mathematical statements by means of a computer is described. The main features of this method are; an analytical mathematical proof of an unusual reliable inference from a single to a common of the form if there exists n* such that Q(n*) holds then for all n>n* P(n) is true where Q and P are some number-theoretical predicates and a reduction of the proof of the common mathematical statement P(n) for all n≥n* to a computer searching of a unique single natural number n* (a unique acupuncture point of the infinite natural number series) which possesses a unique collection of number-theoretical properties Q(n*). If such the acupuncture number n* is found then it can prove the common statement P(n) for all n≥1, possibly except for some n≤n*.

Using a so-called Cognitive Computer Graphics (CCG), visualization of abstract number-theoretical objects, the proof can be reduced in many cases to a demonstration of the corresponding CCG-pictures; the strict mathematical proof is reduced to a visually ostensive one. One of such ostensive proofs of real number-theoretical theorems is given. Relations of the Super-induction method to other known ones are briefly described (Birdie *et al*., 2007).

GENERALIZATION OF THE COMPLETE MATHEMATICAL INDUCTION

It is most fantastical that in general case, there are no restrictions to number-theoretical predicates P and Q. Indeed, one can take any P and any dependence Q = f (P). The most terrible what can occur is that you simply will not prove the corresponding EA-theorem and nothing more? For example, let P be an arbitrary number-theoretical predicate. Then, using the choice freedom, we can define a new predicate Q = f (P) say as follows:

$$Q(n^*) \equiv P(n^*),\ \left[\forall n > n^*\left[P(n) \rightarrow P(n+1)\right]\right] \quad (1)$$

Where n* is now a variable natural number. Since, n in Eq. 1 is a bound variable, the predicate Q (n*) depends really from n* only. So even by a pure formal way, substituting this Q (n*) in EA-theorem (Eq. 2), we obtain:

$$\exists n^* Q(n^*) \rightarrow \forall n > n^* P(n) \quad (2)$$

$$\exists n^*\left[P(n^*),\ \left[\forall n > n^*\begin{bmatrix}P(n)\rightarrow\\ P(n+1)\end{bmatrix}\right]\right] \rightarrow \forall n > n^* P(n) \quad (3)$$

As it is easy to see, the expression (Eq. 4) is the famous complete mathematical Induction method by B. Pascal in its more correct notation than its traditional notation:

$$P(n^*),\left[\forall n > n^*\begin{bmatrix}P^*(n)\rightarrow\\ P(n+1)\end{bmatrix}\right] \rightarrow \forall r > n^* P^*(n) \quad (4)$$

The Super-induction method works fine in such areas of discrete mathematics where the usual mathematical Induction method simply does not work. Today, the choice of the predicate Q for a given predicate P and the formulation of the mathematical connection Q = f (P) in the EA-theorems do not have a theory, i.e., they are quite irrational, i.e., pure intuitive, informal, actions which realize a natural human-being's aspiration for an unrestricted freedom for the mathematical creativity in complete accordance with the famous slogan by George Cantor. Of course, till this aspiration leads us out reasonable frames (Chase *et al*., 1990).

SUPER-INDUCTION METHOD

The Super-induction (SI) method itself is based on the EA-theorems and has the following absolutely evident and natural formulation:

- It is necessary to prove a given general statement $\forall n \geq 1 * P(n)$
- A conditional EA-statement $\exists n^* Q(n^*) \rightarrow \forall n > n^* P(n)$

Is constructed (is devised) where the number-theoretical predicates Q and P are distinct, i.e:

$$Q = f(P) \neq P$$

- The EA-statement is proved analytically (i.e., as usually, less general statements are deduced from more general ones)
- The truth of the single statement, $n^* Q(n^*)$ of the (already after point, EA-theorem is proved, i.e., a natural number n^*, possessing the number-theoretical property Q is found)
- If such a unique number n^* is successfully found then the proved truth of the single statement, $n^* Q(n^*)$ and the proved truth of the EA-theorem, $n^* Q(n^*) \rightarrow n > n^* P(n)$ imply (by modus ponens) the authentic truth of the general statement, $n > n^* P(n)$
- The truth of the predicate P(n) is checked for all $n \leq n^*$:
  - If $n \leq n^* P(n)$ then $n \geq 1 P(n)$ is proved
  - Otherwise, all elements of the finite exclusive set, $N^* = \{1 \leq n \leq n^* : \neg P(n)\}$ were found
- The general statement is proved in the form: $n \geq 1 P(n)$ except for $n \in N^*$

So, the logical and mathematical sense of the Super-induction method is shown in Fig. 1.

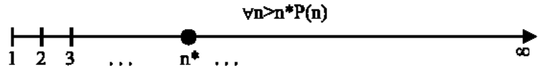

Fig. 1: The logical of mathematical infinity of the Godlike series (1) if we have found a single threshold n^*, possessing the property $Q(n^*)$ then we know all about the behaviour of the property P(n) for all $n > n^*$ up to infinity

Structural model of the logical object method: Recall that if A is an alphabet, symbols of which are names of quantum of quantized signal and if T is a naturally ordered set of non-negative integers interpreted as the time moments then $A^T = \{T \rightarrow A: 0 \rightarrow a_{i1}, 1 \rightarrow a_{i2}, \ldots (= a^0 a^1 \ldots)\}$ is a set of all words above A in particular, $A^{(\upsilon)} = \{\{\upsilon\} \rightarrow A: \nu \rightarrow a(= a^{\upsilon})\} = \{a^{\upsilon}\}$, it is a set of all words above A of unit length and $A^{\circ} = \{\varnothing \rightarrow A: \rightarrow a(= e)\} = \{e\}$ where, e is an empty word. Let X, S, Y be an input alphabet, state alphabet and output alphabet, respectively. Let us introduce in the general case partial (incompletely defined) functions of transition δ and outputs Mealy λ or Moore λ_M:

$$\delta: S^{\{\upsilon\}} \times X^{\{\upsilon\}} \rightarrow S^{\{\upsilon+1\}} : \langle s^{\upsilon}, x^{\upsilon} \rangle \rightarrow s^{\upsilon+1}$$

or (that is admissible from the physical point of view):

$$\delta : S^{\{\upsilon\}} \times X^{\{\upsilon\}} \rightarrow (S^{\{\upsilon+1\}}) : \langle s^{\upsilon}, x^{\upsilon} \rangle \rightarrow pred^{\upsilon}(s^{\upsilon+1})$$

Where:

$$(S^{\{\upsilon+1\}})^{\{\upsilon\}} = \{\{\nu\} \rightarrow S^{\{\upsilon+1\}} : \upsilon \rightarrow s^{\{\upsilon+1\}} (= pred^{\upsilon}(s^{\upsilon+1}))\}$$

and $pred^{\upsilon}(s^{\upsilon+1})$ is a current predication of state-descendant $s^{\upsilon+1}$:

$$\lambda/\lambda_M : S^{\{\upsilon\}} \times X^{\{\upsilon\}} \rightarrow Y^{\{\upsilon\}}: \langle s^{\upsilon}, [x]^{\upsilon} \rangle) ** y^{\upsilon}$$

Where:

$$[X] = X/\{e\}$$

and:

$$[x] = x/e$$

Usage of δ transition functions and λ/λ_M outputs instead of more general ratios is justified by the reason that artificial CU, the logical circuits are determinate (in extreme case pseudo non determinate) whether they include natural may be non determinate LO (natural factors) or not. Consider static LO as an object for which $S = \{s\}$ ($|S| = 1$), i.e., for which we can formally (but not actually) ignore the transition function ($\delta : \{s\}^{\{\upsilon\}} \times X^{\{\upsilon\}} \rightarrow (\{s\}^{\{\upsilon+1\}})^{\{\upsilon\}} : \langle s^{\upsilon}, x^{\upsilon} \rangle \rightarrow s$) and modify function of Mealy outputs $\lambda: X^{\{\upsilon\}} \rightarrow Y^{\{\upsilon\}} : x^{\upsilon} \rightarrow y^{\upsilon}$ ($\lambda : \{s\}^{\upsilon} \times X^{\{\upsilon\}} \rightarrow Y^{\{\upsilon\}} : \langle s^{\upsilon}, x^{\upsilon} \rangle \rightarrow y^{\upsilon}$). There is no point in modification of Moore function because $\lambda M: \{s\}^{\upsilon} \rightarrow Y^{\{\upsilon\}} : s \rightarrow y^{\upsilon}$ is a constant output word of unit length. Thus, the finite-automation mode of static LO is the ordered triad (Chong and Rugina, 2003; Deutsch, 1994):

$$SL = (X, Y, \lambda)$$

where, λ: $X^{(\upsilon)} \rightarrow Y^{(\upsilon)}$: $x^{\upsilon} ** y^{\upsilon}$ or λ: $X \rightarrow^{\}}$: $x ** y$ is the output function. It is immediately obvious that behavior of static LO (SLO) is combinatorial.

Structural model of binary static CU which does not include a feedback is directly limited by minimal system of Boolean formulas. Mentioned formulas express Boolean outputs functions in way ensuring determination of the indeterminate values of output functions in order to reach minimal complexity of the projected scheme of CU. Note that without Static CU introduction it would be fundamentally impossible to construct its structural model. Dynamic LO is an object for which $|S|>1$. Thus, the Finite-automation model of Dynamic LO is the ordered pentad:

$$DL = (X, S, Y, \boldsymbol{\delta}, \lambda/\lambda/_{m})$$

It is actually that behavior of dynamic LO is consequent or incredible as it may seem, it is also combinatorial because if the function of outputs Mealy λ is used and quantity of states of dynamic CU with combinatorial behavior is minimized then as a result, the static object is obtained. Let us introduce traditionally the transitions generalized function:

$$\boldsymbol{\delta} : S^{\{0\}} \times X^{\{0, 1 ..., \upsilon\}} \rightarrow (S^{\{\upsilon+1\}}): \langle s^0, x^0, x^1. x. ^{\upsilon} \rangle \rightarrow s^{\{\upsilon+1\}}$$

Thus, if $x^0x^1.x.^{\upsilon}$ is an admissible output word in state s^0 then;

$$\boldsymbol{\delta}(s^0, x^0, x^1. x.^{\upsilon}) = \boldsymbol{\delta}(\boldsymbol{\delta}(s^0, x^0, x^1. x. ^{\upsilon-1}), x^{\upsilon}$$

If apply on input of LO being in an initial state s^0, the input word $x^0x^1.x. ^{\upsilon}$ admissible in s^0 then the output word corresponding to it will be as follows:

$$y^0 y^1. y.^{\upsilon} = \lambda (s^0, x^0) \lambda (s^1, x^1). \lambda (s^{\upsilon}, x^{\upsilon})$$

$$[y^0] y^1y^2.y. ^{\upsilon+1} = [\lambda_M (s^0)] \lambda_M (s^2). ^0)] \lambda_M (s^{\upsilon+1})$$

Dynamic LO is understood to be its such a consequent behavior at which in case of object controlling x^{μ}, admissible in s^{μ}, LO transits from s^{μ} to $\boldsymbol{\delta}(s^{\mu}, x^{\mu}) = s^{\mu+1}$ and gives the response $\lambda_M(s^{\mu+1}) = y^{\mu+1}$ and in this case, the state s^{μ} parameterize the input-output pair (x^{μ}, y^{μ}) at $\mu = 0, 1, \upsilon$. But if the behavior of LO of Mealy type with not minimal quantity of states or the behavior of LO of Moore type is combinational one then not with standing, the fact that its behavior is similar to consequent behavior, it is pointless to consider it as dynamic one. Therefore, we believe that consistently executed transitions between LO states caused by the different influences is just necessary but not sufficient condition of dynamism of the object. Sufficiently, LO is its own activity or automatism of realization of the transitions sequence caused by the same influence, i.e., if LO will be influenced by words $x^0x^1.x.^{\upsilon}$ at $x^0 = x^1 = \ldots = x = x$ or $x^0x^1.x.^{\mu-1}$ $x^{\mu}.x^{\mu+ik}.x.^{\mu+(i+1)k-1-}$ at $x^0 = x^1 = \ldots = x^{\mu-1} = x^{(i+1)k-1} = x$, $i = 1, 2\ldots$ then, respectively, either (Chong and Rugina, 2003):

$$\delta\left(S^0, x^0x^1.x^{\upsilon}\right) = \delta^{\upsilon+1}$$

$$s^{\upsilon} \neq s^{\upsilon+1}\left(\nu = 0, 1, ..., \upsilon\right)$$

$$\delta\left(s^{\upsilon+1}, x^{\upsilon}\right) = s^{\upsilon+1}$$

i.e., the acyclic sequence of transitions ends in a steady (equilibrium) state $s^{\upsilon+1}$ as regard to $x...^{\upsilon}$ or:

$$\delta\left(S^0, x^0x^1.x^{\mu-1}\right) = s^{\mu} = \delta\begin{pmatrix} s^{\mu+i\kappa}, x^{\mu+i\kappa} \\ x^{\mu+i\kappa+1}.x^{\mu+(i+1)\kappa-1} \end{pmatrix} = s^{\mu+(i+1)\kappa}$$

$$s^{\vartheta} \neq S^{\vartheta+1}\left(\vartheta = 0, 1, \mu-1\right)$$

and;

$$s^{\mu+i\kappa+j} \neq s^{\mu+i\kappa}$$

The object having passed acyclic sequence of transitions, gets in its final state in infinite (practically to final number of times) repeated cycle of states with period κ ($\kappa>0$) (Fig. 1).

For example, the structural model of binary dynamic CU, a prototype (contains feedback) represents a scheme of canonic decomposition of required binary static structural model which is projected in such a way that at excitation of a corresponding binary dynamic substitute of the prototype (as a rule, the parallel register of so-called remembering binary modules), it carried out transitions between own states, similar to transitions between the prototype states. The structure of the initial decomposition also includes binary output structural model (Birdie *et al*., 2007; Chase *et al*., 1990).

As the substitute of set CU is also a dynamic CU, the sufficient conditions of dynamism are not obvious because the structural model of LO automatically pass the set trajectory under the influence of the same control.

Finite-automation model of control object: Considering CO as natural object, it is accepted for non-determinate object (at that the accident is caused by the influences on CO of implicit disturbances) or for determinate with obviously expressed disturbances (Dolby and Chien, 2000). Thus, it is traditionally assumed that the ratio in particular function of transitions δ, looks like:

$$\delta : S^{(\upsilon)} \times U^{(\upsilon)} \times S^{(\upsilon+1)} : \langle s^{\upsilon}, x^{\upsilon}, s^{\upsilon+1} \rangle$$

$$\delta : S^{(\upsilon)} \times U^{(\upsilon)} \times Z^{(\upsilon)} \rightarrow S^{(\upsilon+1)} : \langle s^{\upsilon}, x^{\upsilon}, s^{\upsilon+1} \rangle \rightarrow s\{\upsilon+1\}$$

where, U, Z is alphabet of controls and obvious disturbances, respectively. It is also assumed that for injective and in particular for identical Moore outputs function λ_M, the following is valid:

$$\lambda_M : S^{(\upsilon+1)} \rightarrow Y^{(\upsilon+1)} : s^{\upsilon} \rightarrow y^{\upsilon}$$

So, it is assumed that the ordered pentad is the final-automatic model of CO.

$$CL = (U\,(Z), S.y, \delta, \lambda_M)$$

As a rule possessing the finite automation, one tries to find the finite automation model of artificial, i.e., determined, Controlling Device (CD), believing that its transitions between own states are similar to transitions between states of CO that is obviously pointless. Because if to accept Mealy finite automaton for CD model then minimizing number of its states, we receive static CD that quite corresponds to control according to Bellman because for definition of current control u^{ζ}, it is enough to have a current state $s^{\zeta} = \lambda_M^{-1}(y^{\zeta})$. However, the standard understanding of the logical control as the actions made on CO by the controlling device in the system of automatic logical control (SALC, Fig. 2) by means of controls sequence face with the invincible obstacle. The given obstacle is what $s^{\upsilon+1}$ steady relative u^{υ} to it can be left only in the event if CD will be constrained to give such control $u^{\upsilon+1}$ under $s^{\upsilon+1}$, what $u^{\upsilon+1} \neq = u^{\upsilon}$. In other case if using control $u^{\mu+ik}$, researchers get from the state $s^{\mu+ik}$ into finite circuit with period k, it can be left from the state $s^{\mu+ik}$ only by means of such control $u^{\mu+(l+1)k}$; what $u^{\mu+ik} \neq u^{\mu+(l+1)k}$ (Fig. 3). The given critical weakness of the logical control being used lies in the assumption that the sufficient conditions of CO dynamism are satisfied and this connected with the fact that the CD designers who had previously created the structural models of CU dealt only with the dynamic objects and that is why, it is reasonable that they consider the technological objects as dynamic ones. CU Designer during identification of CO unwittingly tries to add to the control object the dynamism property. However, the set technological object is not the dynamic but only potentially dynamic. Therefore, it is necessary to reformulate the task of logical control by potentially dynamic CO ensuring the CO

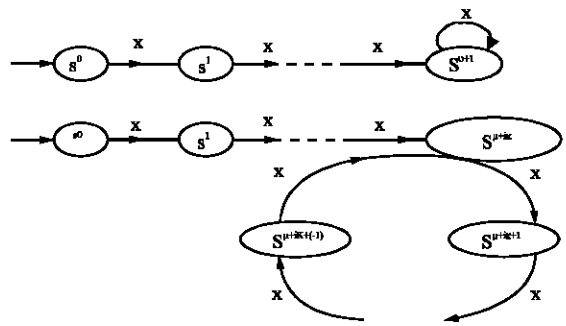

Fig. 2: Sufficient condition of LO dynamism

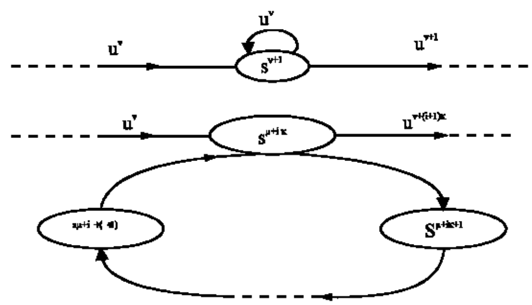

Fig. 3: Logical control conflicts

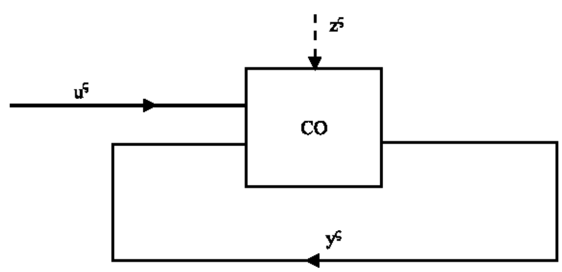

Fig. 4: Dynamic CO block scheme

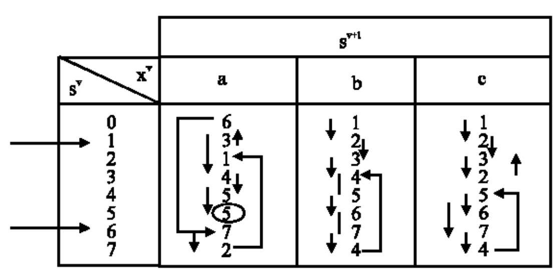

Fig. 5: Sufficient condition of LO dynamism

dynamism. Thus, the finite-automation dynamic model of set potentially dynamic control objects (PCO, Fig. 4 and 5) or control pseudo-object is the ordered pentad:

$$CPL = (U, S, \delta, \lambda_M)$$

(a)

s^v \ u^v	s^{v+1} a	b
1	2	2
2	4	3,4
3	3	2
4	3	4

(b)

s^v \ $u^v s^v$	s^{v+1} a1	a2	a3	a4	b1	b2	b3	b4
1	2				2			
2		4				3, 4		
3			3				2	
4				3				4

Fig. 6: a) Illustration and b) dynamic CO

The ratio in particular function of transitions δ of the given pentad, satisfying the sufficient condition of dynamism looks like:

$$\delta : S^{(\upsilon)} \times U^{(\upsilon)} \times Y^{(\upsilon)} \rightarrow S^{(\upsilon+1)} : \left\langle s^{\upsilon},\, u^{\upsilon},\, \lambda_M^{-1}\left(y^{\upsilon}\right),\, s^{\upsilon+1} \right\rangle$$

or:

$$\delta : S^{(\upsilon)} \times U^{(\upsilon)} \times Y^{(\upsilon)} \times Z^{(\upsilon)} \rightarrow S^{(\upsilon+1)} : \left\langle s^{\upsilon}, u^{\upsilon}, \lambda_M^{-1}\left(y^{\upsilon}\right), z^{\upsilon} \right\rangle ** s^{\upsilon+1}$$

where, λ_M is the injective, specially identical outputs function λ_M: $S^{(\upsilon)} \rightarrow Y^{(\upsilon)}$: $s^v ** Y^{\upsilon}$. Let for example, PCO be set by the table of transitions (Fig. 6a). Then, it is possible to construct the table of transitions of the dynamic CO (Fig. 6b).

CONCLUSION

Thus, the present research reveals the problem of logical object identification taking into account solving of two absolutely various tasks that is constructions of Logical structural model of the object and technological device logical control. Issues of construction control object Finite-automation model is considered. It was shown that by transformation of set potentially dynamic technological object (pseudo-object) into dynamic control object.

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