

The Plan of a Construction as a Sentence
in an Artificial Intelligence Language

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KEYWORDS

CAD, Construction, Artificial Language, Algebraic Structure

ABSTRACT

In building systems the upbuilding of a construction or the plan of a building can be described by abstract algebraic structures. An expression of this algebraic structure is a sentence which has as meaning the building itself.

Le projet d'exécution comme une phrase
d'un langage artificiel

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MOTS CLÉS:

CAO, construction, étude, informatique,
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Sommaire:

On peut décrire la préparation d'une construction, le projet d'un édifice - dans le cadre d'un système constructif - avec des structures algébriques abstraites. Une expression de cette structure algébrique est une phrase, qui signifie l'édifice.

INTRODUCTION

Le processus de conception, dans le cadre des systèmes constructifs est à voir à la figure 1.

Le client raconte verbalement ses idées au concepteur, le concepteur ou l'architecte prépare la conception d'ouvrage qui est basée aux exigences du client et l'ordinateur forme le projet architectural dans le cadre des possibilités du système constructif et donne le projet d'ouvrage. A la base de ce projet la construction peut être réalisée.

Dans cet article nous nous occupons de la préparation automatique du projet, c'est à dire de projet d'exécution d'ouvrage. Notre but est démontrer comment peuvent être utilisés l'algèbre abstraite [3] et les langages artificiels [1,2] à la description du projet d'exécution d'un édifice.

LES RÈGLES DANS LES SCIENCES HUMAINES

Les gens pensent, que les règles rigoureuses ne sont que dans les sciences techniques. Selon nous la poésie est vraiment une science humaine et malgré ça le vers mesuré à l'antique s'assujettit aux lois rigoureuses. Voyons un exemple d'Aeneis de Vergilius:

$\bar{A} \check{R} \bar{M} \bar{A}$	$\check{V} \bar{I} \check{R} \bar{U} \check{M} \check{Q} \bar{U} \bar{E}$	$\check{C} \bar{A} \bar{L} \bar{O}$	$\bar{T} \bar{R} \bar{O} \bar{I} \bar{A} \bar{E}$	$\bar{Q} \bar{U} \bar{I}$
		$\bar{P} \bar{R} \bar{I} \bar{M} \bar{U} \bar{S}$	$\bar{A} \bar{B}$	$\bar{O} \bar{R} \bar{I} \bar{S}$
$\bar{I} \bar{T} \bar{A} \bar{L} \bar{I} \bar{A} \bar{M}$	$\bar{F} \bar{A} \bar{T} \bar{O}$	$\check{P} \check{R} \bar{O} \check{F} \bar{U} \check{G} \bar{U} \bar{S}$	$\bar{L} \bar{A} \bar{V} \bar{I} \bar{N} \bar{A} \check{Q} \bar{U} \bar{E}$	
		$\bar{V} \bar{E} \bar{N} \bar{I} \bar{T}$		

En établissant la grammaire de Chomsky des hexamètres nous pouvons définir un quadruplet:

$$G = /T, N, S, P/,$$

dans laquelle:

$$T = \{ \cup, - \}$$

est l'ensemble des symboles terminaux,

$$N = \{ \text{PIRRICHIUS, IAMBUS, TROCHAEUS,} \\ \text{DACTYLUS, ANAPAESTUS, SPONDEUS,} \\ \text{HEXAMETER, ALTERN 1, ALTERN 2} \}$$

est l'ensemble des symboles non -terminaux,

$$S = \{ \text{HEXAMETER} \}$$

est le symbole de phrase et

$$P = \{ \text{PIRRICHIUS} = \cup\cup, \text{IAMBUS} = \cup-, \\ \text{TROCHAEUS} = -\cup, \text{DACTYLUS} = -\cup\cup, \\ \text{ANAPAESTUS} = \cup\cup-, \text{SPONDEUS} = --, \\ \text{ALTERN 1} = \text{DACTYLUS,} \\ \text{ALTERN 1} = \text{SPONDEUS,} \\ \text{ALTERN 2} = \text{TROCHAEUS,} \\ \text{ALTERN 2} = \text{SPONDEUS,} \\ \text{HEXAMETER} = \text{ALTERN 1} \\ \text{ALTERN 1 ALTERN 1} \\ \text{ALTERN 1 DACTYLUS} \\ \text{ALTERN 2} \}$$

est l'ensemble des règles de construction

/l'ensemble des règles de production, l'ensemble des règles de réécriture/.

Le langage artificiel généré par la grammaire G est:

$$L(G) = \{ X \mid S \Rightarrow^+ X, X \in T^* \}.$$

Le symbole \Rightarrow^+ signifie qu'il est possible déduire quelque chose de S, et $T^* = \lim_{n \rightarrow \infty} (\epsilon \cup T \cup T^2 \cup \dots \cup T^n \dots)$ signifie la clôture de l'ensemble T par ϵ est l'élément de null/.

LES RÈGLES DANS LA CONSTRUCTION PRIMITIVE

Les éléments d'un système constructif forment une ensemble /fig.2/ et sur cette ensemble on peut définir des opérations: superposer, juxtaposer, colorer en... etc. On peut voir, que ainsi nous acceptons une structure algébrique. Dans cette structure algébrique on peut écrire des expressions algébriques. Quelques expressions sont présentées sur la figure 3 et nous pouvons décrire précisément la grammaire suivante du langage de cette structure algébrique:

$$G = (T, H, S, P),$$

$$T = \{ (,), \phi, \Pi, \odot, \ominus, \oplus, !, R, B, H, F \},$$

$$H = \{ \langle \text{UNE TOUR} \rangle, \langle \text{COULEUR} \rangle \},$$

$$S = \{ \langle \text{UNE TOUR} \rangle \},$$

$$P = \{ \langle \text{UNE TOUR} \rangle \rightarrow \langle \text{COULEUR} \rangle \odot (\langle \text{UNE TOUR} \rangle),$$

$$\langle \text{UNE TOUR} \rangle \rightarrow \phi,$$

$$\langle \text{UNE TOUR} \rangle \rightarrow \Pi,$$

$$\langle \text{UNE TOUR} \rangle \rightarrow (\langle \text{UNE TOUR} \rangle) \ominus (\langle \text{UNE TOUR} \rangle)$$

$$\langle \text{UNE TOUR} \rangle \rightarrow (\langle \text{UNE TOUR} \rangle) \oplus (\langle \text{UNE TOUR} \rangle),$$

$$\langle \text{UNE TOUR} \rangle \rightarrow (\langle \text{UNE TOUR} \rangle) ! (\langle \text{UNE TOUR} \rangle),$$

$$\langle \text{COULEUR} \rangle \rightarrow R,$$

$$\langle \text{COULEUR} \rangle \rightarrow B,$$

$$\langle \text{COULEUR} \rangle \rightarrow H,$$

$$\langle \text{COULEUR} \rangle \rightarrow F \}.$$

UNE GRAMMAIRE POUR LES POUTRES CONTINUES

Dans le domaine des structures hyperstatiques on peut décrire par exemple les poutres continues avec une grammaire de chaîne. En définissant quatre éléments de cette structure /fig.4/, il est aussi possible de construire sa grammaire de Chomsky.

$$T = \{ X \in R, H_0, H_1, H_2, H_3, H_4, H_5, H_6, H_7, H_8, H_9, H_{10}, H_{11}, H_{12}, H_{13}, H_{14}, H_{15}, H_{16}, H_{17}, H_{18}, H_{19}, H_{20}, H_{21}, H_{22}, H_{23}, H_{24}, H_{25}, H_{26}, H_{27}, H_{28}, H_{29}, H_{30}, H_{31}, H_{32}, H_{33}, H_{34}, H_{35}, H_{36}, H_{37}, H_{38}, H_{39}, H_{40}, H_{41}, H_{42}, H_{43}, H_{44}, H_{45}, H_{46}, H_{47}, H_{48}, H_{49}, H_{50}, H_{51}, H_{52}, H_{53}, H_{54}, H_{55}, H_{56}, H_{57}, H_{58}, H_{59}, H_{60}, H_{61}, H_{62}, H_{63}, H_{64}, H_{65}, H_{66}, H_{67}, H_{68}, H_{69}, H_{70}, H_{71}, H_{72}, H_{73}, H_{74}, H_{75}, H_{76}, H_{77}, H_{78}, H_{79}, H_{80}, H_{81}, H_{82}, H_{83}, H_{84}, H_{85}, H_{86}, H_{87}, H_{88}, H_{89}, H_{90}, H_{91}, H_{92}, H_{93}, H_{94}, H_{95}, H_{96}, H_{97}, H_{98}, H_{99}, H_{100}, H_{101}, H_{102}, H_{103}, H_{104}, H_{105}, H_{106}, H_{107}, H_{108}, H_{109}, H_{110}, H_{111}, H_{112}, H_{113}, H_{114}, H_{115}, H_{116}, H_{117}, H_{118}, H_{119}, H_{120}, H_{121}, H_{122}, H_{123}, H_{124}, H_{125}, H_{126}, H_{127}, H_{128}, H_{129}, H_{130}, H_{131}, H_{132}, H_{133}, H_{134}, H_{135}, H_{136}, H_{137}, H_{138}, H_{139}, H_{140}, H_{141}, H_{142}, H_{143}, H_{144}, H_{145}, H_{146}, H_{147}, H_{148}, H_{149}, H_{150}, H_{151}, H_{152}, H_{153}, H_{154}, H_{155}, H_{156}, H_{157}, H_{158}, H_{159}, H_{160}, H_{161}, H_{162}, H_{163}, H_{164}, H_{165}, H_{166}, H_{167}, H_{168}, H_{169}, H_{170}, H_{171}, H_{172}, H_{173}, H_{174}, H_{175}, H_{176}, H_{177}, H_{178}, H_{179}, H_{180}, H_{181}, H_{182}, H_{183}, H_{184}, H_{185}, H_{186}, H_{187}, H_{188}, H_{189}, H_{190}, H_{191}, H_{192}, H_{193}, H_{194}, H_{195}, H_{196}, H_{197}, H_{198}, H_{199}, H_{200}, H_{201}, H_{202}, H_{203}, H_{204}, H_{205}, H_{206}, H_{207}, H_{208}, H_{209}, H_{210}, H_{211}, H_{212}, H_{213}, H_{214}, H_{215}, H_{216}, H_{217}, H_{218}, H_{219}, H_{220}, H_{221}, H_{222}, H_{223}, H_{224}, H_{225}, H_{226}, H_{227}, H_{228}, H_{229}, H_{230}, H_{231}, H_{232}, H_{233}, H_{234}, H_{235}, H_{236}, H_{237}, H_{238}, H_{239}, H_{240}, H_{241}, H_{242}, H_{243}, H_{244}, H_{245}, H_{246}, H_{247}, H_{248}, H_{249}, H_{250}, H_{251}, H_{252}, H_{253}, H_{254}, H_{255}, H_{256}, H_{257}, H_{258}, H_{259}, H_{260}, H_{261}, H_{262}, H_{263}, H_{264}, H_{265}, H_{266}, H_{267}, H_{268}, H_{269}, H_{270}, H_{271}, H_{272}, H_{273}, H_{274}, H_{275}, H_{276}, H_{277}, H_{278}, H_{279}, H_{280}, H_{281}, H_{282}, H_{283}, H_{284}, H_{285}, H_{286}, H_{287}, H_{288}, H_{289}, H_{290}, H_{291}, H_{292}, H_{293}, H_{294}, H_{295}, H_{296}, H_{297}, H_{298}, H_{299}, H_{300}, H_{301}, H_{302}, H_{303}, H_{304}, H_{305}, H_{306}, H_{307}, H_{308}, H_{309}, H_{310}, H_{311}, H_{312}, H_{313}, H_{314}, H_{315}, H_{316}, H_{317}, H_{318}, H_{319}, H_{320}, H_{321}, H_{322}, H_{323}, H_{324}, H_{325}, H_{326}, H_{327}, H_{328}, H_{329}, H_{330}, H_{331}, H_{332}, H_{333}, H_{334}, H_{335}, H_{336}, H_{337}, H_{338}, H_{339}, H_{340}, H_{341}, H_{342}, H_{343}, H_{344}, H_{345}, H_{346}, H_{347}, H_{348}, H_{349}, H_{350}, H_{351}, H_{352}, H_{353}, H_{354}, H_{355}, H_{356}, H_{357}, H_{358}, H_{359}, H_{360}, H_{361}, H_{362}, H_{363}, H_{364}, H_{365}, H_{366}, H_{367}, H_{368}, H_{369}, H_{370}, H_{371}, H_{372}, H_{373}, H_{374}, H_{375}, H_{376}, H_{377}, H_{378}, H_{379}, H_{380}, H_{381}, H_{382}, H_{383}, H_{384}, H_{385}, H_{386}, H_{387}, H_{388}, H_{389}, H_{390}, H_{391}, H_{392}, H_{393}, H_{394}, H_{395}, H_{396}, H_{397}, H_{398}, H_{399}, H_{400}, H_{401}, H_{402}, H_{403}, H_{404}, H_{405}, H_{406}, H_{407}, H_{408}, H_{409}, H_{410}, H_{411}, H_{412}, H_{413}, H_{414}, H_{415}, H_{416}, H_{417}, H_{418}, H_{419}, H_{420}, H_{421}, H_{422}, H_{423}, H_{424}, H_{425}, H_{426}, H_{427}, H_{428}, H_{429}, H_{430}, H_{431}, H_{432}, H_{433}, H_{434}, H_{435}, H_{436}, H_{437}, H_{438}, H_{439}, H_{440}, H_{441}, H_{442}, H_{443}, H_{444}, H_{445}, H_{446}, H_{447}, H_{448}, H_{449}, H_{450}, H_{451}, H_{452}, H_{453}, H_{454}, H_{455}, 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$$H = \{ \langle \text{POUTRE CONTINUE} \rangle, \langle \text{STRUCTURE} \rangle, \langle \text{POINT INITIAL} \rangle, \langle \text{PARTIE DE MILIEU} \rangle, \langle \text{TERMINAISON DU POUTRE} \rangle, \langle \text{POINT DE POUTRE} \rangle, \langle \text{TROUÇON DE POUTRE} \rangle, \langle H \rangle, \langle HH \rangle \}.$$

$S = \{ \langle \text{POUTRE CONTINUE} \rangle \},$
 $P = \{ \langle \text{POUTRE CONTINUE} \rangle \rightarrow \langle \text{STRUCTURE} \rangle,$
 $\langle \text{STRUCTURE} \rangle \rightarrow \langle \text{POINT INITIAL} \rangle \langle \text{PARTIE DE MILIEU} \rangle \langle \text{TERMINAISON DE POUTRE} \rangle,$
 $\langle \text{PARTIE DE MILIEU} \rangle \rightarrow \langle \text{POINT DE POUTRE} \rangle$
 $\langle \text{PARTIE DE MILIEU} \rangle \rightarrow \langle \text{PARTIE DE MILIEU} \rangle \langle \text{TROUÇON DE POUTRE} \rangle,$
 $\langle \text{PARTIE DE MILIEU} \rangle \rightarrow \langle \text{TROUÇON DE POUTRE} \rangle \langle \text{PARTIE DE MILIEU} \rangle,$
 $\langle \text{POINT INITIAL} \rangle \rightarrow \text{INIT} [\langle u \rangle, \langle u \rangle, \langle u \rangle, \langle u \rangle],$
 $\langle \text{TERMINAISON DE POUTRE} \rangle \rightarrow \text{TERM} [\langle u \rangle, \langle u \rangle, \langle u \rangle, \langle u \rangle],$
 $\langle \text{POINT DE POUTRE} \rangle \rightarrow \text{POIN} [\langle uu \rangle, \langle uu \rangle],$
 $\langle \text{TROUÇON DE POUTRE} \rangle \rightarrow \text{TROU} [\langle uu \rangle, \langle uu \rangle, \langle uu \rangle, \langle uu \rangle],$
 $\langle uu \rangle \rightarrow \epsilon R, \text{ (LES NOMBRES RÉELS)}$
 $\langle u \rangle \rightarrow \langle uu \rangle,$
 $\langle u \rangle \rightarrow \langle uu \rangle \text{ (VALEUR NON DÉFINI)} \}.$

UNE GRAMMAIRE DU SYSTÈME CONSTRUCTIF

Si dans le système constructif les éléments ont plus que deux terminaisons /plus que deux points de contact/, ou si dans un noeud ils se branchent plus que deux éléments, il n'est pas possible de décrire la structure avec des langages de chaîne et on ne peut pas caractériser la structure avec des grammaires linéaires. Dans ce cas il faut utiliser des langages multidimensionnels [2]. Une de ses grammaires est la grammaire "plex".

La grammaire "plex" montre un sextolet:

$$G_{\text{plex}} = (T, N, S, P, Q, q_0),$$

dans lequel T, N, S et P sont des ensembles déjà définis, Q est un ensemble fini des identificateurs des points de contact, et $q_0 \in Q$ est un identificateur spécial, qui est utilisé, dans des cas, si un élément ne contacte pas un certain noeud. Nous avons utilisé cette grammaire pour décrire le système constructif /ÉTISZK/ développé dans notre institut. Une grammaire d'un tel vrai système constructif est très compliqué, pour détailler dans cette article, sa description se trouve à la référence [6].

CONCLUSIONS

Les systèmes constructifs ont des éléments, et si nous en construisons, alors nous utilisons des opérations sur ces éléments. On peut voir, que dans ce cas nous pouvons travailler dans le cadre d'une structure algébrique abstraite [4]. Quand nous voulons décrire les expressions de ces structures algébriques, il faut utiliser un langage artificiel [5]. Les règles de sa grammaire sont les règles des systèmes constructifs. Une phrase, une expression algébrique est équivalente d'un projet d'exécution d'une construction. Cette direction de recherches prend sa place déjà aussi dans la littérature technique mondiale [7, 8].

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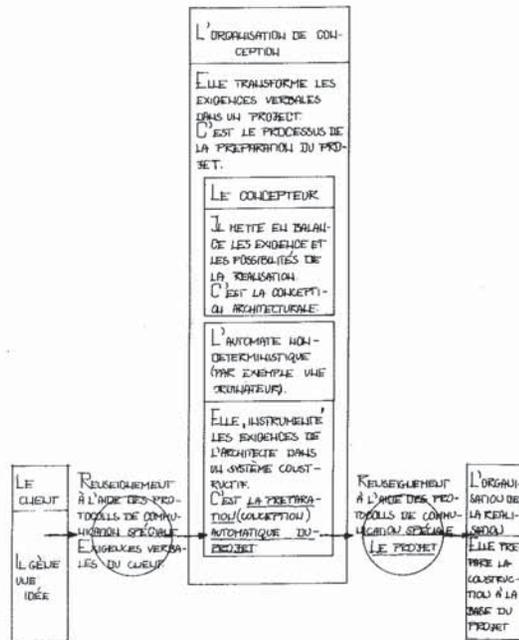


fig. 1 Le processus de conception.

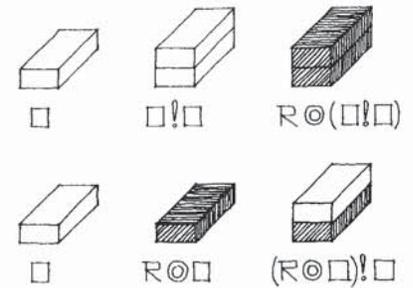
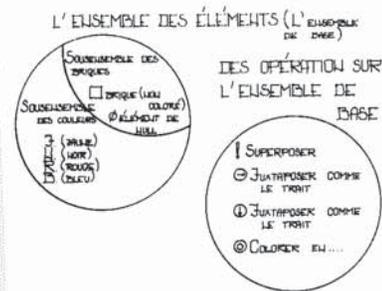


fig. 2 L'algèbre de la construction primitive.

fig. 3 Expressions algébriques dans une construction primitive.

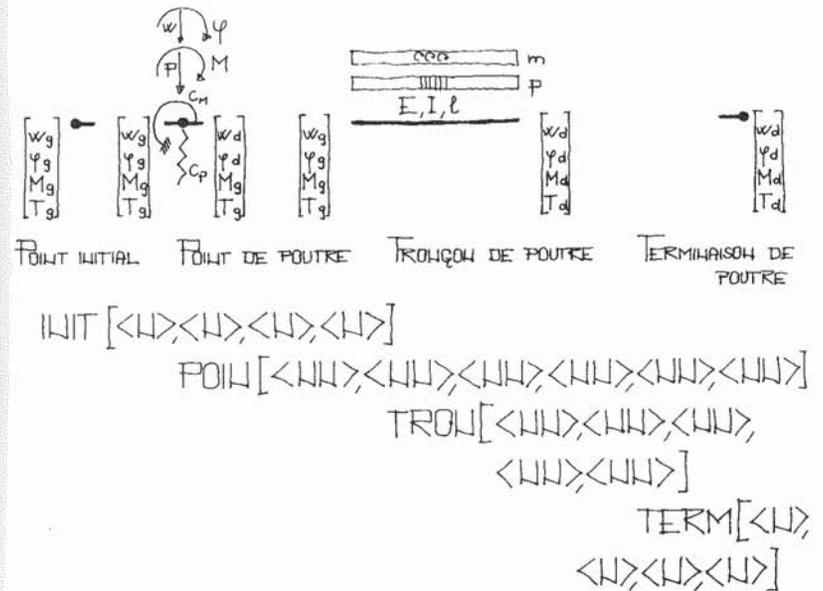


fig. 4 Les éléments des poutres continues.