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Optimal Decision in Industry Choices

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KEY WORDS
Optimalisation of fuzzy choices, sharpnes of decision and entropy dependence

ABSTRACT
The article gives one of the possibility of generalisation for optimal decissions about choices in robust industry systems. The task come from theory of fuzzy logic. Using all possible information about categories for choice in fuzzy systems there are possibility to transform the fuzzy decision to real sharp decission. The article describe the dependence of this sharpness on entropy of choice sets. The process has two or more phases and asked sharp result can get in spite of existence the high uncertainty at the end of choice. The method can take as universal procedure for different fieds of industry and other purphoses.

1. Introduction

There are many cases of non linear processes control. We can not apply any control systems without basic information about the dynamics of the processes. The ability and even possibility to create a control system is dependent on knowledge of the type of non-linearity, which can influence the main process and states in the process as well as output levels of this system. It is necessary to take into consideration this important law as well. There are many robust systems for a task about a choice of equipment which will consist on. Optimal and right decission about basic compounds in any system is a task about even perfect choice or indipendent selection as well. The next analysis takes possibility for solution of this task.

2. Variables for Fuzzy Design

The first design step of fuzzy choice is a primary connectivity function as one of similar functions in very complicated cases of robust systems. Conjunctive (multiplicative) field, or connectivity field, of the first level for decisions as per Tab.1 contains as a horizontal argument a set of commodity items {Ti}m and for the value of the connectivity function for coverage of international market is in form:

$$f_T[T_i]_{i=1}^{m} = D_{Ti} \tag{1}$$

The vertical argument is a factory subject from the set of manufacturers {Fj}n and their function value

$$f_F[F_j]_{j=1}^{n} = D_{Fj} \tag{2}$$

as a coverage of offered items from the manufacturer set. For determination of optimal state on the market, the following condition can be considered:

$$\max_{i,j}\{D_{Ti} \times D_{Fj}\} \geq \varepsilon \tag{3}$$

where ε is a border of optimality. The argument of function (3) is shown in Fig.1.

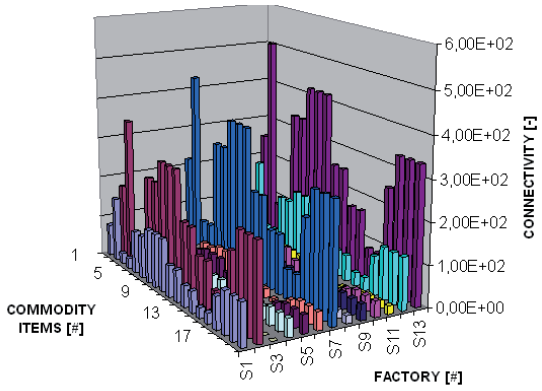

Fig. 1: *Analysis of market field.*

In Tab.1, the + sign denotes a positive case and * denotes an uncertain case. Items no.18 and no.19 had progressed onto the second level of decision.

3. Second Level of Choice

Decision about only one of commodity items is slightly easier. The new connectivity field contains as a horizontal coordinate all the offered properties of equipment for gas analysis. The horizontal coordinate can be a logical binary number B from the set of decisions: $\{B_x\}_{x=1}^{z}$. Vertical argument is the set $\{F_y\}_{y=1}^{u}$ where u is a limit chosen from the first level of choice. Function values of vertical argument are the prices of equipment c_y.

The rating of connectivity can be written as follows:

$$R = \min_{x,y}\left[c_y \times \sum_{x=1}^{z} \overline{B_x} \cdot k_x\right] = \min_{x,y} A \qquad (4)$$

where k_x is an importance number or weighing coefficient for comparison of properties.

Using Tab. 2, the function of connectivity was created in the form of argument A according to expression (4). It is necessary to determine an upper limit of the price cy for a decision about the rating of R.

There is neccesary to remak that influence of logical binary function B on finaly decision by expression (4) has property of unsymetricity, so expertise for optimal second step must be created as the set for hardly negative crossing out. Owing to full complementarity in logical full set of asked phenomena must be taken to consider this important fact for expertise. Finaly decision consist of creating the table of expertise and finaly rating by (4).

4. Entropy of Choices

The final decision about determination of the types of equipment can be made by a human expert. By increasing the quantity z, the entropy as well as uncertainty of choice (4) is increasing. If cy is a constant, then the value of expression (5) grows depending on z as a number from a binary range in the second level of choices, so

$$\max(\log_2 A) = c_y \cdot \log_2 z \qquad (5)$$

Logarithmic tendence of dispersion can see on the Fig. 2 in rating order by Tab. 2.

Table 1: *Matrix of connectivity.*

ITEM	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	D_B %
D_{Ti}	3	6	1	1	4	4	5	5	5	3	3	2	2	1	1	3	4	4	4	
COMETSYSTEM info@cometsystem.cz	-	+	-	-	-	-	+	+	+	*	*	-	-	-	-	*	+	-	-	26
MARET maret@maret.sk	+	+	-	-	+	+	+	+	+	+	+	*	*	*	*	+	+	-	-	58
SMART info@smart.cz	-	-	-	-	*	-	*	*	*	*	*	*	*	*	*	*	*	-	-	0
AMIT amit@amit.cz	-	+	-	-	*	-	*	*	*	*	*	*	*	*	*	*	+	*	*	11
HORIBA horiba@horiba.cz	-	-	-	-	-	-	-	-	-	-	-	*	*	*	*	*	-	+	+	11
YOKOGAWA maring@yokogawa.cz	-	-	-	-	-	-	-	-	-	-	-	*	*	*	*	*	-	+	+	11
SIEMENS kontakt.sk@siemens.com	+	+	-	-	+	+	+	+	+	+	+	+	+	*	*	+	*	+	+	73
PROTRONIX info@protronix.cz	-	+	-	-	*	-	*	*	*	*	*	*	*	*	*	*	*	*	*	5
AFRISO info@afriso.cz	-	-	-	-	*	-	*	*	*	*	*	*	*	*	*	*	*	+	+	10
TESTO info@testo.cz	-	-	-	-	-	-	-	-	-	-	-	*	*	*	*	*	-	+	+	10
ADDAT info@addat.cz	-	-	-	-	*	-	*	*	*	*	*	*	*	*	*	*	+	*	-	5
ZPA zpa@zpa.cz	-	+	-	-	+	+	+	+	+	*	*	-	-	*	*	*	-	-	-	32
ZPANP obchod@zpanp.cz	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	84

Table 2: *Finaly expertise.*

SELECT OF ITEMS (Tab.3)	Σ PRICE [€]	$\overline{B_1}$ NDIR	$\overline{B_2}$ ABILITY OF GAS CLEANING	$\overline{B_3}$ GAS COOLING	$\overline{B_4} \cdot 2$ FULL ANALYSIS	$\overline{B_5}$ MAINT. PERIOD	$\overline{B_6}$ PRICE TRESHOLD EXCEEDED	RATING A [#]
1. (1, 2)	21 035	0	1	0	2	0	0	63 105
2. (3)	23 290	0	0	0	2	0	0	46 580
3. (4, 5)	14 633	0	1	0	2	0	0	43 899
4. (5, 6)	16 292	0	1	0	0	0	0	16 292
5. (7)	9 048	1	0	0	2	1	0	36 192
6. (8)	43 500	0	0	0	0	0	1	43 500
7. (9)	35 754	0	0	0	0	0	1	35 754
8. (13)	9 869	1	1	1	2	0	0	49 345

#	FACTORY	Order in offer	MODEL	METHODE	PRICE €
1	HORIBA	ICZ 110215	VA-3011, 19"	2 IR: NO, CO	14 723,00
2	HORIBA	ICZ 110215	XMTC-62-11, in 19"	1: H_2	6 312,00
3	SIEMENS	A&D PI-1101-3859	LSD 6	1: NDIR, Laser, IN-SITU	23 290,00
4	SIEMENS	A&D PI-1103-4020	ULTRAMAT 23, 19"	3 IR: CO, CH_4, CO_2	8 608,00
5	SIEMENS	A&D PI-1103-4020	CALOMAT 62, 19"	1: H_2 ELECTROCHEMICAL CO_2 IN H_2	6 025,0
6	SIEMENS	A&D PI-1103-4020	ULTRAMAT 23+, 19"	3 IR+OXYGEN: CO, CH_4, CO_2, $+O_2$	10 267,20
7	TESTO	K-TEST, 24.2.2011	Testo 350 S/XL	9: O2, CO, CO2 (NDIR)+H_2, NOx (NO a NO2), SO2, H_2S, C_xH_y	9 048,9
8	MADUR	18.03.2011	PHOTON II.	5 IR:CO, CO_2, NO, NO_2, CXHy, $+H_2$	43 500,00
9	MADUR	18.03.2011	CMS-7, STOJAN	6 IR COMPONENTS 3 IR: CO, CO_2, CH_4, $+H_2$	35 754,00
10	MADUR	18.03.2011	maMoS-100,	1 z : CO, CO_2, CH_4, O_2	3 687,00
11	MADUR	18.03.2011	maMoS-200	2 z: CO, CO_2, CH_4, O_2	5 976,00
12	MADUR	18.03.2011	maMoS-300	3 z: CO, CO_2, CH_4, O_2	7 973,00
13	MADUR	18.03.2011	maMoS-400	4 z: CO, CO_2, CH_4, O_2	9 859,00

Fig. 3: *Specification of choosen range*

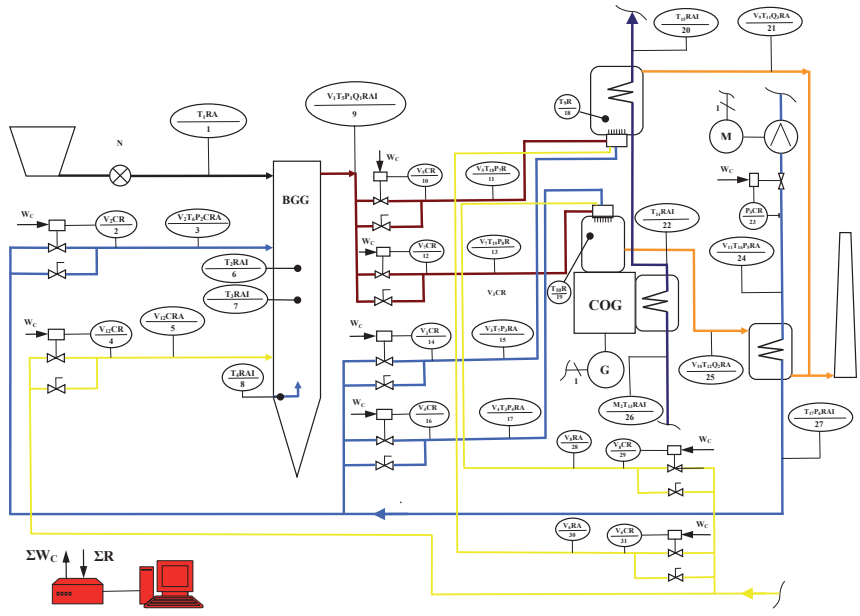

Fig. 4: *Complete robust control system*

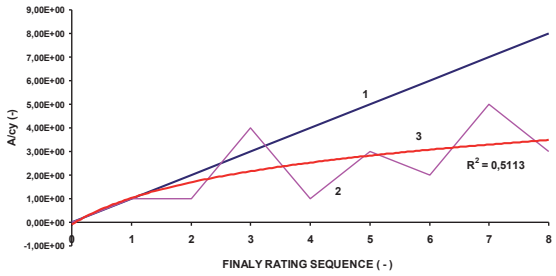

Fig. 2: *Logarithmic dispersion of discrete choices (lines: 1- reference, 2- A/cy , 3- regression).*

5. Results and Conclusion

As shown in Tab. 2 using formula (4), the best rating of A was achieved by system no. 4 (two systems components 5. and 6. from Tab.2). It is necessary to remark that without the condition about exceeding the price threshold, many more items can achieve the same decision rating. Just as important is the weighing coefficient for B4 for obtaining a substitution of an attitude of a knowledge expert. The decision process without this method takes too much time.

Above all, with respect to result (5), the fact was proven that under any circumstances, exact results without a human factor as an expertise cannot be made.

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