THE MAKING AND IMPLEMENTATION OF AN EXPERT SOFTWARE FOR IDENTIFYING THE OPTIMAL SURFACES FOR GRABBING A COMPONENT HANDLED BY A VACUUM PREHENSILE DEVICE

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ABSTRACT: The scientific paper realized by the authors describes a scientific method for a quick identifying of the optimal grabbing surfaces, for a injected component type Sigma stow grip. By making, implementing and running the conceived expert system, the surface for an optimal grabbing are determined in a very short time, and the points where the devices cup axes for vacuum grabbing will have to be perpendicular on the discussed surfaces.

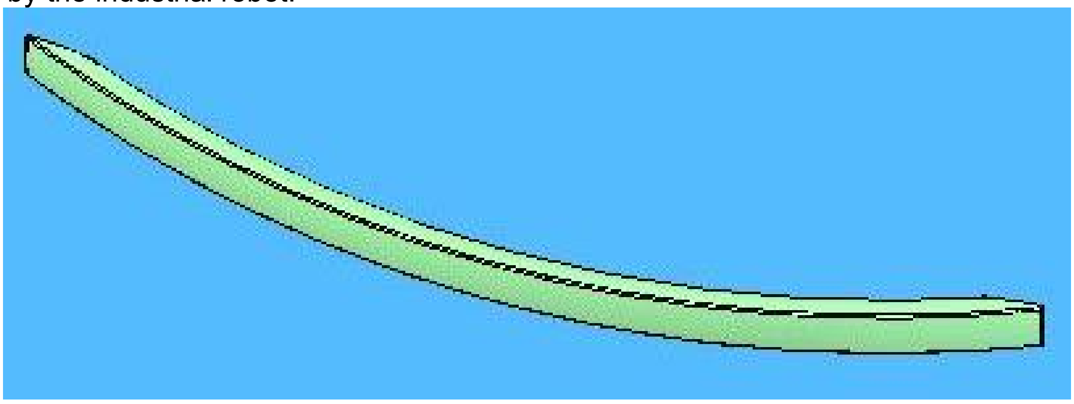
KEYWORDS: Expert system, Sigma stove grip, vacuum grabbing device

1. INTRODUCTION

In the work is presented a method of optimized construction for a vacuum grabbing device used in the simultaneous extraction of two injected components type Sigma stove grip, by running a quick and precise identifying program for the optimal grabbing surfaces of the devices cups used for vacuum grabbing, used for both components extracted from the injecting mold, and handled by the industrial robot.

2. CALCULATION OF THE SUCKERS POSITION

By using a expert system developed by the authors and running the designed programs, the position values and orientations of the suckers have been determined. In picture 1 is presented the 3D Model of the handled component named "**sigma_grip**".

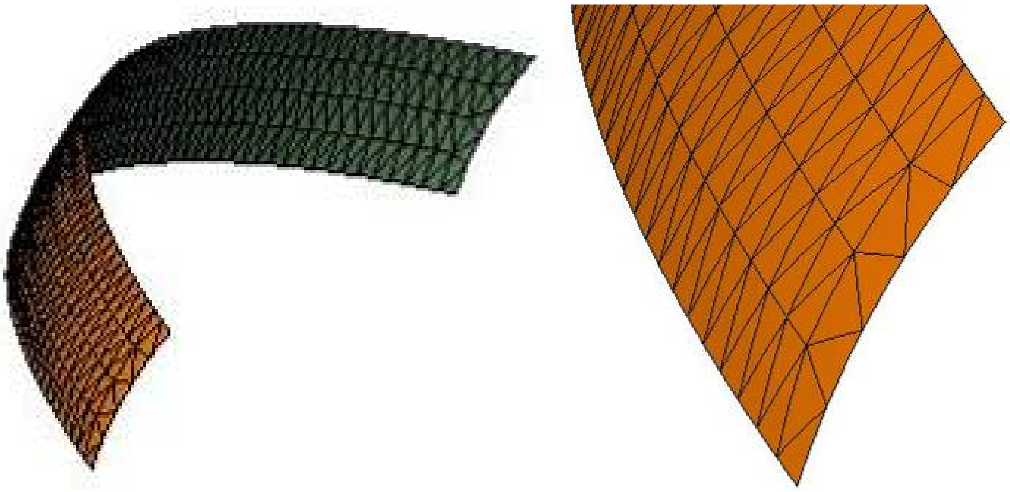


Picture 1. The 3D Model of the component named "sigma_grip".

In the following we presented an exact way of application of an expert system for determining, on scientific basis, the optimum grabbing areas on the surfaces of the object handled by an industrial robot, more and more used in the injecting systems.

As a starting point, we chose the 3D model of the injected and manipulated component, component which has been selected and imported in the software COSMOSWORKS, where we have selected the grabbing surfaces and the network has been realized with triangular elements. So there were generated 1281 nods and 564 elements, which have been exported in a corresponding ASCII folder.

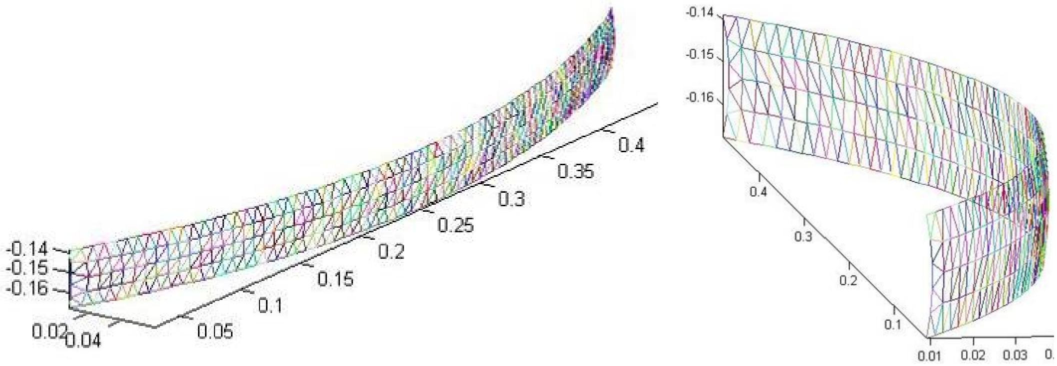
In picture 2 is presented the network obtained with the software COSMOSWORKS.



Picture 2. Network realized with the software COSMOS

The generated ASCII file was then processed with the help of two computer software conceived and realized by the authors.

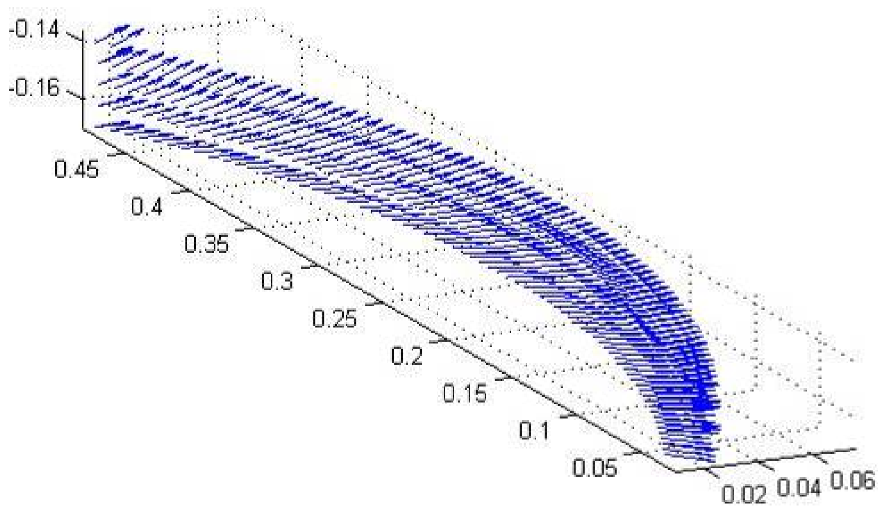
As a result of the software process it has been obtained first of all, the nods and elements matrix (graphically presented in picture 3).



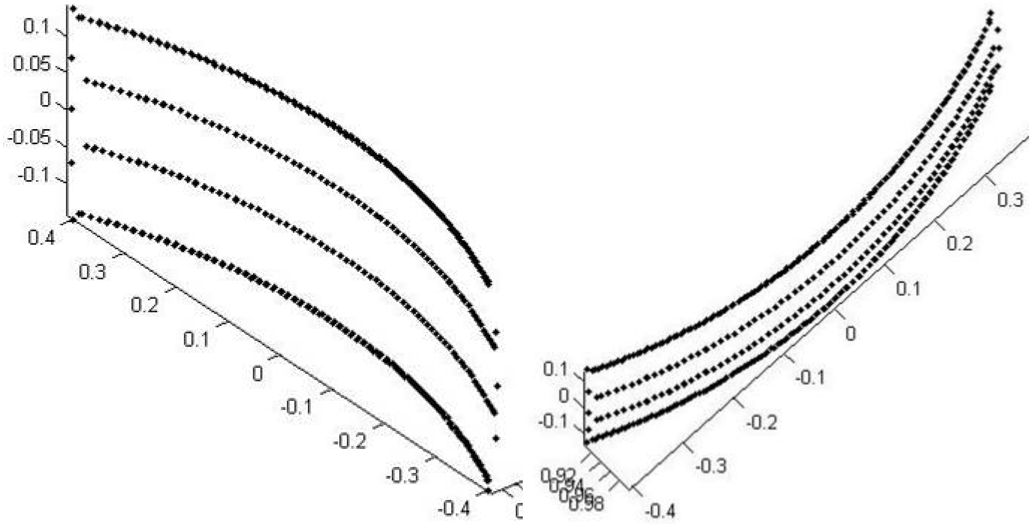
Picture 3. Network presented in the MATLAB software.

On which basis the normal on each triangular element have been calculated (graphically presented in picture 4)

The representation in the normal parameter space is presented in picture 5.

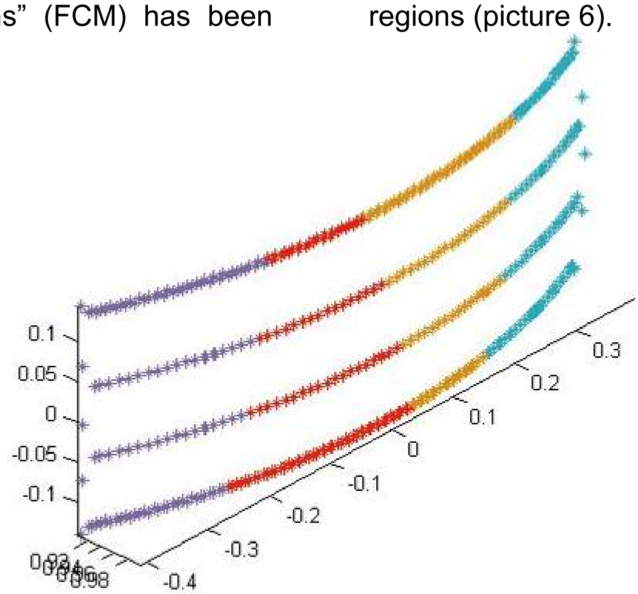


Picture 4. The normal presentation in the cartesian space Oxyz.



Picture 5. Presentation the normal parameters space.

Having as starting data the normal parameters matrix, the program based on the method "Fuzzy C-means" (FCM) has been processed and it has been obtained the partition of the normal parameters field in 4 regions (picture 6).



Picture 6.Partition presentation for the domain of the surface normal parameters.

The software based on the FCM method allows the specification of an arbitrary number of regions or the specification of the limit values of the normal parameters which fall in a certain region.

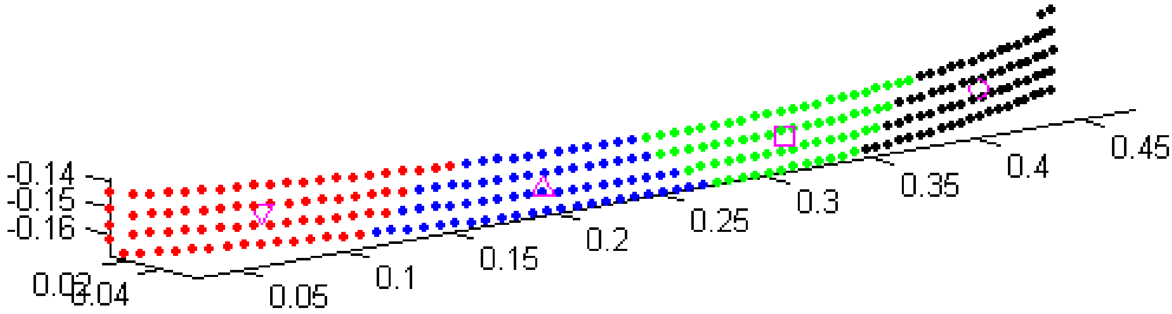
These characteristics can be selected by the human operator.

From the realized program are obtained:

1. The coordinate matrix by regions MR_xyz
2. The normal parameters matrix by regions MR_uvw
3. The center points coordinates matrix MC_xyz
4. The normal parameter matrix of the center points MC_uvw

In the next step we will select the suckers from a database (BDV) (stage in which the human operator intervenes as a decisional factor). This database gathers the next defining elements for each cup: the cup's dimensions - (Ø, B/A, A, B, H, L, M etc), the suction force – F. The maximum adjusting angle – α of each cup is known.

In the following the authors have realized a software by which they can obtain the positions of the domain centers (table 1), and the normal parameters which represent each domain center (picture 7, according to the values from table 2). The principal cosinus values used for orientating the cups are given in table 2.



Picture 7. Partition presentation for the domain of the surface normal parameters and the domain centers.

Table 1.

Region	Coordinate X	Coordinate Y	Coordinate Z
1	0.0300	0.0850	-0.1561
2	0.0542	0.3130	-0.1551
3	0.0539	0.1982	-0.1587
4	0.0303	0.4251	-0.1574

Table 2.

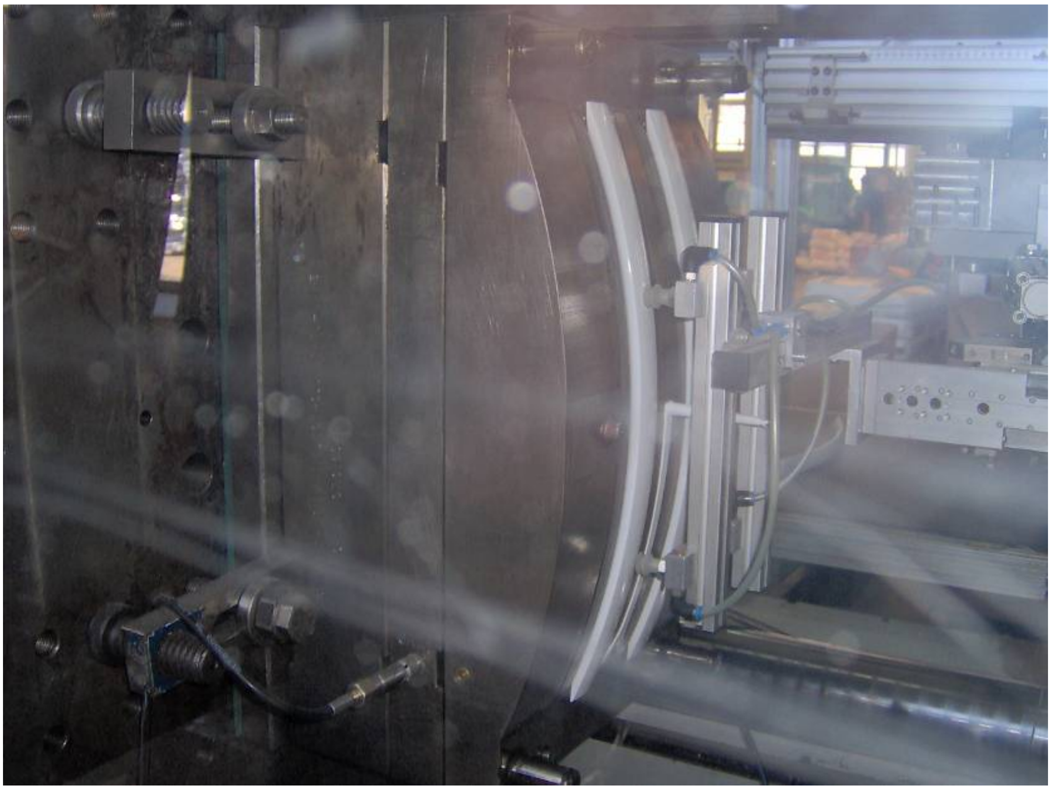
Center number	Normal parameter value (director cosinus)		
	A	b	c
1	0.9863	-0.1043	0.0286
2	0.9859	0.1082	0.0288
3	0.9450	-0.3051	0.0115
4	0.9439	0.3086	-0.0117

Based on the determined and presented values from table 2 adjustments will be realized for a precise orientation on the chosen grabbing surfaces, for each of the four suckers from the vacuum prehensile device structure, which realizes the simult-aneous grabbing of two components like Sigma oven grip. In the situation of the two components presented in picture 8 the optimal grabbing surfaces will be at the ex-tremities, more exactly the surfaces 1 and 4.

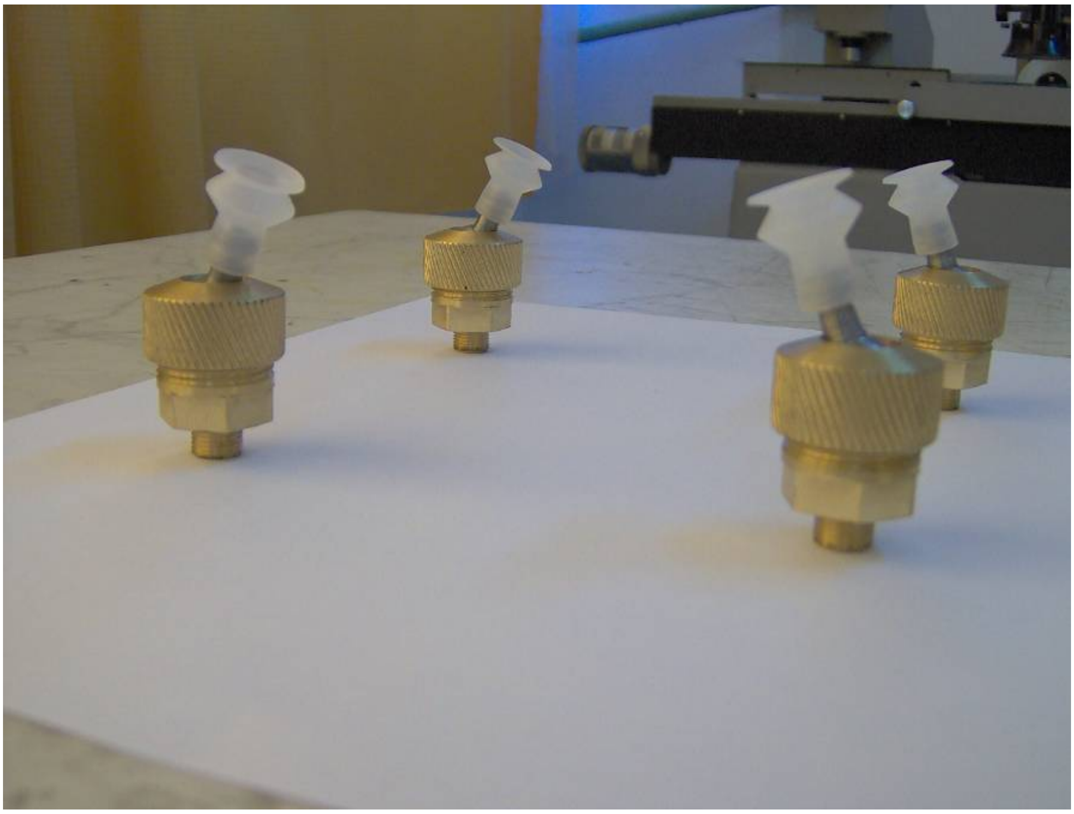
3. CONCLUSIONS

Using in practice the method described in the paper, it has been determined on scientific basis the exact position of the sucker centers, which are positioned in the centers of the areas defined previously, and the normal parameter values which are the bases for the calculation of the placing angels for the suckers.

The human operator will position and orientate each cup, according to the calculated placing parameters, and it will result the configuration of the vacuum prehensile device in the optimum grabbing way. Using the information's offered by the expert system and by the four modules of flexible cup holders in the next paper will be realized more experiments on a robotized injecting system.



Picture 8. Presentation of the two oven grips SIGMA which are extracted simultaneously from the mold



Picture 9. The flexible cup holder modules, realized in practice

REFERENCES

[1] ***Tocuţ, P.D.,*** Dispozitive de prehensiune vacuumatice optimizare constructiv-funcţională. Editura Universităţii din Oradea 2008, ISBN 978-973-759-599-7.

[2] ***Tocuţ, P.D.,*** Optimizarea constructivă şi funcţională a dispozitivelor de prehensiune neconvenţionale, Teză de doctorat , Universitatea din Oradea 2007.

[3] ***Tocuţ, P.D.,*** Mihăilă,I., Tripe- Vidican, A. Concepts of final vacuum flexible efectors. ANNALS of the ORADEA UNIVERSITY 2007, ISSN 1583-0691,CNCSIS,,Clasa B+,, CD ROM 821-829.

[4] **Pavel Dănuţ Tocuţ**,Călin Tripe Vidican, Aron Tripe Vidican. Vacuum robot for cleaning the glass frontage of the buildings. ANNALS of the ORADEA UNIVERSITY 2008, ISSN 1583-0691,CNCSIS,,Clasa B+,, CD ROM1118-1125

[5] **Pavel Dănuţ Tocuţ**, R C Ţarcă, T Vesselenyi, Călin Tripe Vidican. An expert system for determining the structure and the configuration of the vacuum prehensile devices used in the extraction of the injected parts. PROCEEDINGS OF 4TH INTERNAŢIONAL CONFERINCE OF ROBOTICS November 13-14, 2008 Braşov, România, Vol. 15(50), Series A, Special issue, ISSN 1223-9631, pag 739-744.

[6] **Pavel Dănuţ Tocuţ**, R C Ţarcă, T Vesselenyi, Călin Tripe Vidican. Constructive optimizations of a prehensile vacuum device with sideway catch. PROCEEDINGS OF 4TH INTERNAŢIONAL CONFERINCE OF ROBOTICS November 13-14, 2008 Braşov, România, Vol. 15(50), Series A, Special issue, ISSN 1223-9631, pag 739-744.

[7] ***Tocuţ, P.D.,*** Studiu privind posibilitatea inlocuirii distribuitorului pneumatic de la efectorul final vacuumatic al manipulatorului MULTILIFT H cu un distribuitor proporţional in vederea optimizării funcţionale al acestuia. Contract nr 4683/3558-2005, între Universitatea din Oradea şi S.C.PLASTOR S.A. Oradea.

[8] ***Program MATLAB***