PN–II–ID–PCE–2008–2

FUNDING APLICATION FOR EXPLORATORY RESEARCH PROJECTS

1. Personal data of the project manager:

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1.6 Doctorate coordinator:	NO (Select)
1.7 Number of candidates for doctor's degree:	0

2. Host institution:

2.1. The name of the institution:	DUNAREA DE JOS UNIVERSITY OF GALATI *[fill in the institution name]*
2.2 Faculty/ Department:	MECHANICAL ENGINEERING / MANUFACTURING SCIENCE AND ENGINEERING
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3. Title of the project: **(Max. 200 characters)**

TOPOLOGICAL GEOMETRY OF MECHANICAL STRUCTURES

4. Key words (max. 5 terms):

1	TOPOLOGICAL MODELING
2	MECHANICAL STRUCTURES
3	
4	
5	

5. Project duration (3 years): **3**

6. Project summary: **(Max. 2000 characters)**

THIS PROJECT PROPOSED TO DEVELOP A NEW APPROACH OF THE MECHANICAL STRUCTURES GEOMETRY, CALLED TOPOLOGICAL APPROACH. THIS APPROACH RESPECTS THE ACTUAL TREND ON THE MACHINING SYSTEM MARKET AS RESULT OF THE ICT DOMAIN TECHNOLOGIES. ANALYZING THE DESIGN AND MANUFACTURING PROCESS EVOLUTION WE CAN REMARK THAT THE INTERFACE BETWEEN A MECHANICAL COMPONENT AND THE ASSEMBLY IS COMPOSED BY AN ELEMENTARY SURFACES GROUP IN CONTACT WITH ANOTHER SURFACES GROUP, IN CONTACT AT NOMINAL LEVEL. THE SURFACES GROUP IS REGARDED AS A UNITARY GEOMETRICAL GROUP WITH COMPLICATED FORM. SIMILARLY AT MECHANICAL COMPONENTS WE CAN REMARK THAT A SURFACES GROUP IS GENERATED BY A SINGLE CLAMPING IN A SINGLE ACTION. AT CONTROL, THE MEASURING DEVICE EXPLORES A SURFACES GROUP AND RETURNS THE DIMENSIONAL, FORM AND POSITION DEVIATIONS. THESE FACTS SUGGEST THAT IS NEEDED TO USE THE NOTION OF TOPOLOGICAL STRUCTURE, DEFINED AS A STRUCTURE COMPOSED BY A SURFACES GROUP, BELONGS TO THE MECHANICAL COMPONENT, AND WHICH, ASSOCIATED WITH ANOTHER GROUP FORM AN INTERFACE. THE WHOLE MECHANICAL CONSTRUCTION MAY BE REGARDED AS BEING COMPOSED BY A NUMBER OF MECHANICAL COMPONENTS AND JOINTS. THE ASSEMBLY OF THESE COMPONENTS AND JOINTS IS SIMILARLY WITH A DIMENSION CHAIN. THE OVERALL OBJECTIVE OF THE PROJECT IS TO IMAGINE A NEW THEORY REGARDING THE GEOMETRICAL ASPECTS OF THE MECHANICAL STRUCTURES, THEORY BASED ON THE TOPOLOGICAL APPROACH.

7. Project presentation:

[Please fill in max. 10 pages in ANNEX 1]

8. Project management:

[Please fill In ANNEX 2]

9. Budget (eligible cost)*:

CRT. NO.	NAME OF THE BUDGET CATEGORY	VALUE 2008*** (euro)	VALUE 2009*** (euro)	VALUE 2010*** (euro)	VALUE 2011*** (euro)	TOTAL VALUE (euro)
1.	**STAFF EXPENSES**** - *max. 60%* including state tax and other contribution	5353	21418	21418	16063	**64250**
2.	**INDIRECT EXPENSES** *(overheads)*	2500	10000	10000	7500	**30000**
3.	**MOBILITIES** *(participation in prestigious scientificevents / documentation; research stages in contry or abroad)*	0	5000	5000	5000	**15000**

4.	**LOGISTIC COSTS** for carrying on the project *(research infrastructure, costs for materials, dissemination etc.)*	1250	34500	30000	25000	**90750**
	TOTAL	**9103**	**70918**	**66418**	**53563**	**200000**

* Structure of budget must be in accordance with the HG 1579/2002

** Staff expanses must be calculated in acordance with the size of research team and HG 475/2007

*** 2008 – 3 month, 2009 – 12 month; 2010 – 12 month; 2011 – 9 month.

10. Project manager is full time employed in the host institution

(Select)

YES

IT IS CERTIFIED HEREBY THE LEGALITY AND CORRECTNESS OF THE DATA INCLUDED IN THE PRESENT FINANCING REQUEST

DATE: 28.02.2008

RECTOR/MANAGER,
Surname, first name: prof. PhD. eng. Viorel Minzu
Signature:
Seal

ACCOUNTING MANAGER/CHIEF ACCOUNTANT
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PROJECT MANAGER,
Surname, first name: PHD. ENG. VIRGIL GABRIEL TEODOR
Signature:

7. Project presentation: (Max. 10 pages)

7.1. Importance and relevance of the scientific content

The presentation creates the research referential; it will demonstrate the project manager's degree of information documentation

The proposed project aim is to develop a new approach of the mechanical structures geometry. This approach is based on the evolution noticed concerning in the design, processing and marketing fields of manufacturing machine, as well as the new support development of information technology. The nowadays trend in the economy, science, technology and society are under the globalization aspect. The customer expectation is at a higher lever concerning the product quality as a result of globalization. Product quality, along with price has become a criterion for economical progress.
On the other hand, in science, information spreading, knowledge, and the emerging of new scientific knowledge significantly increased.
In the technological field the quality assessment trend it is performed in real time and it is integrated in the product manufacturing process. The quality assessment was performed with classical devices, whereas today the product measurement is performed with coordinate measurement machines. Nowadays modern machine tools are able to generate complex surfaces and consequently the issue is not process the surfaces but measuring the surfaces. The dimensional control issue is one of the most important, as a result of small batch, customized according to the customer requirements.
Also is to be noticed the increased work mobility with the increase of training and skill. This involves the using of the knowledge based machining. Latest evolutions in the dimensional control shows that machine tool have implement measurement machines features and the control is an integrated manufacturing process. As an inference, the two phase (processing – measurement) alternate successively.
It is noticed the trend, as well, of deviation compensation strategy replacing error reducing one. Compensation is the action of changing the programmed value of process attributes, in the manner to minimize the deviation (see figure 1).

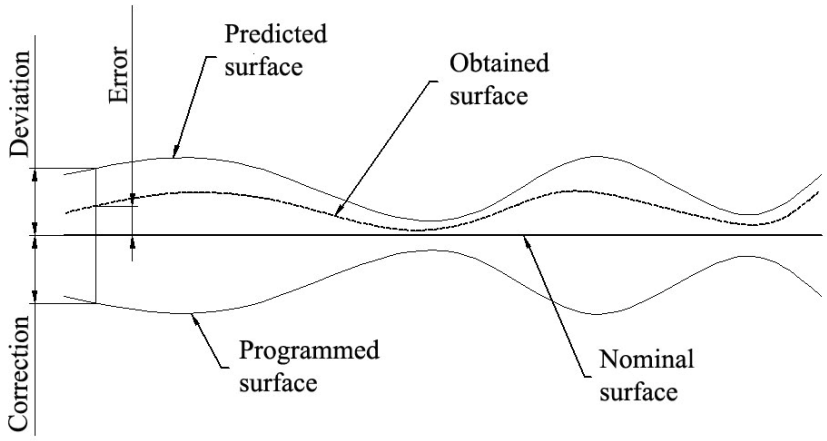

Fig. 1. *Correction process*

Parameter compensation of n sample processing from a batch is performed with the information acquired as a result of 1..n-1 parts possessing.
Taking into account these observations there are several definitions to be stated:
1. The error is the remnant deviation that is determines product quality.
2. Deviation it is the difference between real value of a parameter and the programmed value of the current parameter.
3. Compensation it is the action of programmed value compensation, of a certain attribute, in order to minimize error.
Because of the computer technology it was possible the CAD system, in the first place, and then the emerging of computer aided manufacturing (CAM) systems, followed by computer aided inspection (CAI), where all the information is digitally processed.
This evolution had a direct effect that the Euclidian geometry, which is the base of classic dimensional control, is no longer to be used, as is not appropriate to the computer information. Compared with this trend, the way the mechanical construction geometry the way is described as identification based dimensional tolerancing.
The project is proposing a new approach of the mechanical constructions to reflect scientific evolution and to define dimensional control technique in the manufacturing.
In literature there are two main approaches described in the area of generation, measurement and tollerancing.
The first one is represented by continuous monitoring of the workpiece during the processing [7]. This method is no longer according to the nowadays technology.
The second one is based on dimensioning tolerancing of part functionality [3], [4], [5].
The some are several proposals for mathematical models to diminish error observed of the parts [1], [2], [6], [10].
As we point it out, measurement machine are used on larger scale; the measurement speed is limited by the dynamical errors emerged. The errors can be measured, modeled and predicted using neuronal network [12]. The results show

that it is possible the error compensation using neuronal network [8].
In the current phase, the integration between guide mark design and inspection process can be treated on three levels: geometrical, dimensional, and tolerancing. Usually this integration of all three levels is performed only on geometrical level. As a result, it is an approach of modeling and inspection processes, by intermediary of guide mark model integrations a, dimensioning and torelancing in the guide mark knowledge system [11]. The model it is used to develop a new knowledge based prototype, in order to validate inspection process.
Analyzing the literature it is shown that there is no generalized approach concerning generation, inspection and tolerancing of the mark guide mark surfaces, to regard the surfaces in their assembly location, and it is correct to state that the nowadays standards does not corresponds to the most recent evolution in design and machine toll market.
The project importance is own to the fact that the dimensional control and tollerancing issues is of a tremendous importance, it is noticed the integration trend of these process in the manufacturing. Analyzing the mechanical construction geometry trough topological geometry it is aimed **replacing the singular surface analyzing to surfaces assembly modeling, using topologic approach.** By intermediary of surface assembly we believe that superior result will be acquired concerning precision and the correction possibility in comparison to that of singular surfaces inspection.
The project importance is in the fact there will be performed research considering the base topological assembly modeling concerning the generation control and correction issues in the manufacturing.
Previous research developed by the research team in the present project proposal shows that the results obtained on modeling basis are superior by far to those computed on singular surfaces modeling.
In the proposed project research will be used techniques from different fields, as a continous work performed by the team members (genetic algorithm modeling [9], [12], neuronal based modeling [9], analytical modeling though parameters circulation).

Bibliography

[1] Ahn, K. G., Min, B. K., Pasek, Z. J., *Modeling and compensation of geometric errors in simultaneous cutting using a multi-spindle machine tool*, International Journal of Advanced Manufacturing Technology, 2006, DOI 10.1007/s00170-005-2615-z;
[2] Anselmetti, B., Louati, H., *Generation of manufacturing tolerancing with ISO standards*, International Journal of Machine Tools & Manufacture, 2005, pag. 1124-1131, DOI 10.1016/j.ijmachtools.2005.01.001;
[3] Anselmetti, B., *Generation of functional tolerancing based on positioning features*, Computer Aided Design 38, 2006, pag. 902-929, DOI 10.1016/j.cad.2006.05.005;
[4] Ballu, A., Falarone, H., Chevassus, N., Mathieu, L., *A new Design Method based on Functions and Tolerance Specifications for Product Modelling*, Annals of the CIRP, Vol. 55/1/2006, 2006;
[5] Chen, Y., Huang, M., Yao, J., Zhong, Y., *Optimal concurrent tolerance based on the grey optimal approach*, International Journal of Advanced Manufacturing Technology, 2003, pag. 112-117, DOI 10.1007/s00170-002-1448-2;
[6] Cheraghi, S. H., Jiang, G., Ahmad, J. S., *Evaluating the geometric charachetristics of cylindrical features*, Precision Engineering 27, 2003, pag. 195-204, PII S0141-6359(02)00221-0;
[7] Choudhury, S. K., Jain, V. K., Krishna, S. R., *On-Line Monitoring of Tool Wear and Control of Dimensional Inaccuracy in Turning*, Journal of Manufacturing Science and Engineering, Transactions of ASME, vol. 123, 2001, pag. 10-12, DOI 10.1115/1.1334863;
[8] Dong, C., Zhang, C., Wang, B., Zhang, G., *Prediction and Compensation of Dynamic Errors for Coordinate Measuring Machines*, Journal of Manufacturing Science and Engineering, 2002, vol. 124, pag. 509-514, DOI 10.1115/1.1465435;
[9] Epureanu A., **Teodor V.,** Oancea N., Banu M., Marinescu V., *Method for On-Line Identification of Reconfigurable Machine-Tool Geometry Based on a Topological Neural Approach*, Journal of Manufacturing Science and Engineering (trimisă spre publicare);
[10] Gosavi, A., Phatakwala, S., *A finite-Differences Derivative-Descent Approach for Estimating Form Error in Precision-Manufactured Parts*, Journal of Manufacturing Science and Engineering, Transactions of the ASME, vol. 128, 2006, pag. 355-359;
[11] Hunter, R., Perez, J., Marquez, J., Hernandez, J. C., *Modeling the integration between technological product specifications and inspection process*, Journal of Materials Processing Technology, 191, 2007, pag. 34-38, DOI 10.1016/j.jmatprotec.2007.03.056;
[12] **Teodor V.,** Epureanu A., Cuzmin C., *Method for Identification of Geometric Feature Family Based on Genetic Algorithm and Neural Approach* Procedeeings of WSEAS EUROPEAN COMPUTING CONFERENCE, Athens, Greece, September 25-27, 2007;
[13] Ybao, C., Huang, M., Yao, J., Zhong, Y., *Optimal concurrent tolerance based on the grey optimal approach*, International Journal of Advanced Manufacturing Technology, 22, 2003, pag. 112-117, DOI 10.1007/s00170-002-1448-2;
[14] Liu, Y., Cheng, T., Zuo, L., *Adaptive Control Constraint of Machining Process*, International Journal of Advanced Manufacturing Technology, 17, 2001, pag. 720-726;
[15] El-Mounayri, H., Elbestawi, M. A., Spence, A. D., Bedi, S., *General Geometric Modeling Approach for Machining Process Simulation*, International Journal of Advanced Manufacturing Technology, 13, 1997, pag. 237-247;
[16] Warnecke, G., Kluge, R., *Control of Tolerances in Turning by Predictive Control with Neural Networks*, Journal of Intelligent Manufacturing, 9, 1998, pag. 281-287;
[17] Srinivasan, V., *Standardizing the specification, verification and exchange of product geometry: Research, status*

and trends, Computer-Aided Design, 2007, DOI 10.1016/j.cad2007.06.006;
[18] Prieto, F., Redarce, T., Lepage, R., Boulanger, P., *An Automated Inspection System*, International Journal of Advanced Manufacturing Technology, 19, 2002, pag. 917-925;
[19] Mejbri, H., Anselmetti, B., Mawussi, K., *Functional tolerancing of complex mechanisms: Identification and specification of key parts*, Computers & Industrial Engineering, 49, 2005, pag. 241-265, DOI 10.1016/j.cie.2005.04.002;
[20] van Luttervelt, C. A., Peng, J., *Symbiosis of Modelling and Sensing to Improve the Accuracy of Workpieces in Small Batch Machining Operations*, International Journal of Advanced Manufacturing Technology, 15, 1999, pag. 699-710;
[21] Huang, M. C., Tai, C. C., *The Pre-Processing of Data Points for Curve Fitting in Reverse Engineering*, International Journal of Advanced Manufacturing Technology, 16, 2000, pag. 635-642;
[22] Jung, J., Mayor, R., Ni, J., *Development of Freeform Grinding Methods for Complex Drill Flank Surfaces and Cutting Edge Contours*, International Journal of Machine Tool & Manufacturing, 45, 2005, pag. 93-103;
[23] Ren, K., Ni, J., *Analises of Drill Flute and Cutting Angles*, International Journal of Advanced Manufacturing Technology, 15, 1999, pag. 546-553;
[24] Lee, J. H., Liu, Y., Yang, S. H., *Accuracy Improvement Of Miniaturizing Machine Tool: Geometric Error Modeling And Compensation*, International Journal of Advanced Manufacturing Technology, 46, 2006, pag.1508-1516;
[25] Shi, M., Zhang, Y. F., Loh, H. T., Bradley, C., Wong, Y. S., *Triangular Mesh Generation Employing A Boundary Expansion Technique*, International Journal of Advanced Manufacturing Technology, 30, 2006, pag. 54-60;
[26] Jian, L., Hongxing, L., *Modeling System Error In Batch Machining Based On Genetic Algorithms*, International Journal of Advanced Manufacturing Technology, 43, 2003, pag. 599-604;
[27] Cho, M. W., Kim, G. H., Seo, T. I., Hong, Y. C., Cheng, H. H., *Integrated Machining Error Compensation Method Using OMM Data And Modified PNN Algorithm*, International Journal of Advanced Manufacturing Technology, 43, 2006, pag. 1417-1427;
[28] Ratchev, S., Liu, S., Huang, W., Becker, A. A., *An Advanced FEA Based Force Induced Error Compensation Strategy in Milling*, International Journal of Advanced Manufacturing Technology, 46, 2006, pag. 542-551;
[29] Ratchev, S., Liu, S., Huang, W., Becker, A. A., *Error Compensation Strategy In Milling Flexible Thin-Wall Parts*, International Journal of Advanced Manufacturing Technology, 2005, pag. 673-681;
[30] Sabri, T. E., Can, C., *A Cutting Force Induced Error Elimination Method For Turning Operations*, International Journal of Advanced Manufacturing Technology, 170, 2005, pag. 192-203;
[31] Ratchev, S., Liu, S., Huang, W., Becker, A. A., *Milling Error Prediction And Compensation In Machining Of Low-Rigidity Parts*, International Journal of Advanced Manufacturing Technology, 44, 2004, pag. 1629-1641;
[32] Takahashi, S., *Variational design of curves and surfaces using multiresolution constraints*, The Visual Computer, 14, 1988, pag. 208-227;
[33] Mu, Y. H., Hung, N. P., Ngoi, K. A., *Monitoring A Sub-Newton Cutting Force For Ultra-Precision Machining*, International Journal of Advanced Manufacturing Technology, 16, 2000, pag. 229–232;
[34] Fulin, W., Chuanyun, Y., Tao, W., Yang, S., Zhao, G., *A Generating Method For Digital Gear Tooth Surfaces,* International Journal of Advanced Manufacturing Technology, 28, 2006, pag. 474–485;
[35] Bachmann, K. H., s.a. *Mica enciclopedie matematica*, Editura tehnica Bucuresti, 1980;
[36] Berge, C., *Topological Spaces: Including a Treatment of Multi-Valued Functions, Vector Spaces and Convexity*, Editura Dover Publications, 1997, ISBN-10: 0486696537;
[37] Munkres, J. R., *Topology; A First Course*, Editura Prentice Hall College Div, 2000, ISBN-10: 0139254951;
[38] Okabe, A., Boots, B., Sugihara, K., Chiu, S. N., *Spatial Tessellations: Concepts and Applications of Voronoi Diagrams*, Editura Wiley, 2000, ISBN-10: 0471986356.

7.2. Project objectives

(the project goals must be clearly specified in the context of the knowledge stage in the domain, the original elements focused upon and their importance for the domain, the project evaluated impact; if necessary the interdisciplinary character will be mentioned)

The project goal is representing the development of new approach of mechanical construction geometry, called topological approach. This topological approach is based on nowadays trends in the design, manufacturing, and using areas, as well as ICT domain

Pre-requisites

1. The interface of a mechanical component, between a part or a group of parts, and the rest of the mechanical structure it is composed by group of different elementary surfaces, belonging to the mechanical construction to be assembly with, building a shape and counter-shape, on nominal level. Surfaces group have the some features as a group of elementary surface with complex shape.

2. Similarly, when manufacturing the mechanical component it is noticed that, according to the part program, it is unitary action generating a surfaces group.

3. In the case of inspection, the machine inspection head is exploring a surfaces group with relative position tolerated and returns the dimensions, shape and positioning errors.

These three facts suggesting the necessity of introductions of new topological structure, defined as a structure composed of surfaces group which is associated with another surfaces group, building an interface. The entire mechanical construction may be regarded as the sum of interfaces and mechanical components. This assembly is

similarly to the nowadays concept of dimension chains.

Overall objective is the conceiving a new theory regarding mechanical structure geometry, theory based on topological approach.

Several specific objectives result from main objective

1. Development of the concept of mechanical construction topologic.

Geometrical shape of every processed surface is always different compared to the nominal one. To assure interchanging and to meet functional requirements, geometrical tollerancing are combined with certain surfaces. In order to examine the quality of processed surfaces, the inspection is performed and the choosed points are processed with an algorithm allowing verification of design requirements.

Presently, there are models to identify deviation values (statistical technique, ants colony technique, kinematics modeling) allowing the evaluation of different deviation type that might occur on complex surfaces processing.

Another issue that might be proved as an important is that concerning holistic part geometry approach.

In order to inspect processed surfaces there are used two techniques: the part is explored by a coordinate measurement machine, case which means that there cannot be any procedure to compensate errors.

This inspection techniques (gathering points and building the model) is applied separately on every surface.

Product technical specification imposes restrictions concerning certain parameters (not all deviations, but only those considered important for the functional role of the workpiece). As a consequence, the surface inspection and the finding all deviation according to reference surfaces comprises several unused information, though are computed.

In the industry tollerancing it is performed on surfaces group of a blank and especially those which are in direct contact with another surfaces group, building a shape and counter-shape pair.

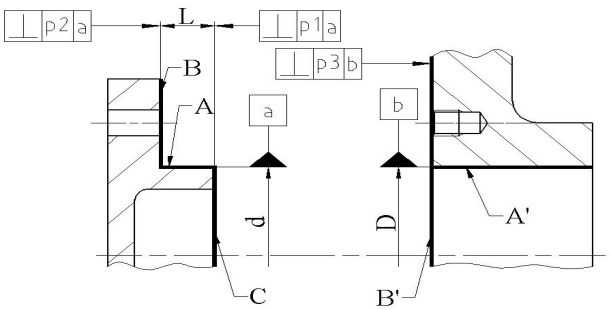

Fig. 2. *Shape counter-shape surfaces*

Tolerancing is referring to assure superposition acceptable exact between shape and counter-shape (see fig. 2). As a result, it is rational to perform ABC surfaces assembly inspection, simultaneously processed three points groups in order to obtain models for the surfaces A, B and C. I**n this way, the unitary surfaces modeling to the surfaces assembly modeling, using topological approach**. Surfaces assembly tolerancing, in the technical specifications, it is performed limiting some of the shape deviations of surfaces assembly. It is tolerated A-C distance, surfaces diameter B, perpendicularity surfaces A reported to B and the parallelism between A and C. These values are the parameter of the shape surface deviation.

Topological approach of assembly surfaces is providing an accurate result compared to the singular surface approach. This result is representing better the correspondence between surfaces assembly.

2. Topological structures identification

It is aimed the identification topological structure trees and the modeling the relations between structures.

This is the way the dimensional chain modeling is replaced with one based on topological structure chain.

Correct identification of topological structure for the functional role of mechanical constructions is of paramount importance for the correct mathematical model design.

3. Mechanical structures topological design principles

Nowadays design methodology is based on singular designing of surfaces describing a mechanical element using dimensions chains to assure functional role in the mechanical constructions. It is assuming that the replacing the way the design is performed today with an original concept, based on topological structures, according to which all surfaces are considered a unitary assembly. This fact is determining the replacing of dimensional chain with topological structure chains. This approach advantages the next phase of identification and modeling based on topological concept of mechanical structures.

Topological structure defining it is done on the criterion according to which all the elements have restrictions concerning shape, dimensions and relative positioning. We underline that a topological structure is not limited only to the current operation generated surfaces.

In order to identify topological structure is necessary to group surfaces for every operation performed, for which there no functional restrictions are concerning relative positioning. These restrictions may have as the reference a processed surface in the current operation or a previous processed surface. Each one of the shape, positioning, dimensioning, and restrictions predicted in the design phase, it is a parameter to meet for the topological structure.

This objective will be finalized with the the building of new design methodology based on mechanical element topological structure.

4. Topological structure control for error compensation.

Topological structure design it is performed on the basis of the criteria that all element of the structure impose restrictions concerning shape, dimensions and their relative positioning. Each of the topological structure surfaces it is described by the models of the parts and the parameters concordance of the real surfaces. In the figure 3 is presented a

topological structure composed of two bore D_1 and D_2 and the surfaces flat *P*, *Q* and *R*. The parameters that determines this topological structures are represented by the bore diameters D_1 ad D_2, distance between the circle center of bore D2 and Q flat (A length), distance between circle of bores (B length), angle between bores axes and distance between p flat to the circle center of the bores (C length).

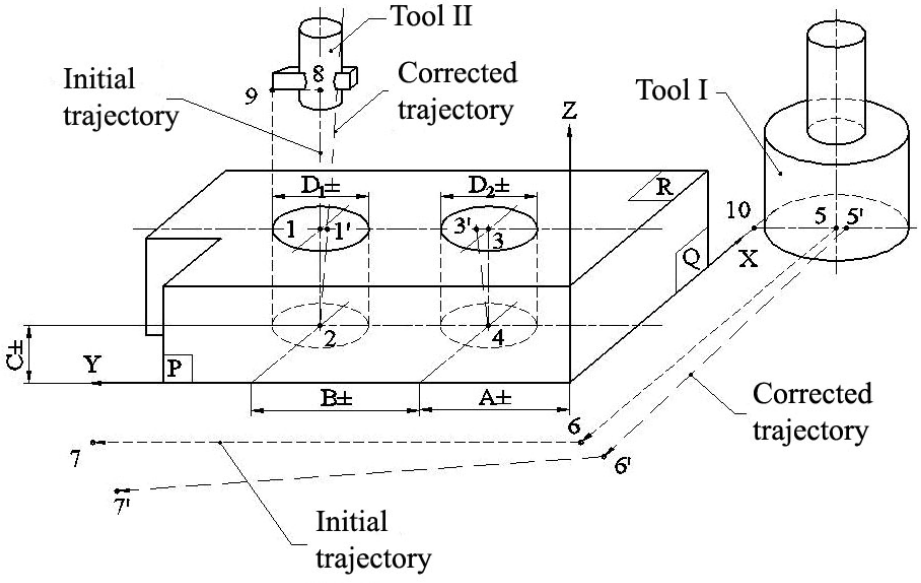

Fig. 3. *Topological structure*

Part program for generating surfaces comprises points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (see figure 3), which is determining tool trajectory for processing. The measurement of the mechanical element it is performed on the some system as processing; the tool is replaced with a feeling system. In the measurement sequences in the part-program it is assigned a suitable trajectory of the touch probe during points coordination extraction. Taking into account that the touch probe contact is a spherical surfaces, the center trajectory of this surface must be represented by equidistance to the theoretical surface to be explored (see figure 4).

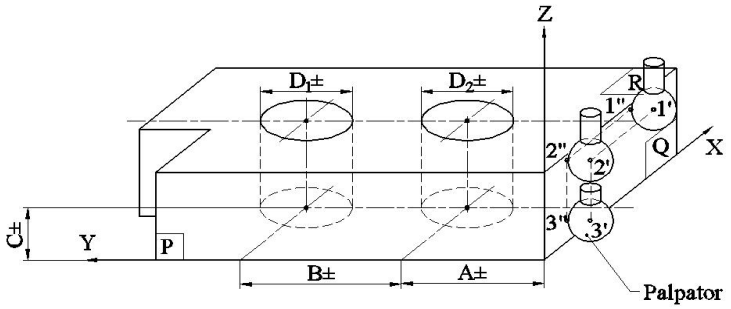

Fig. 4. *Mechanical element control*

For instance, if the measuremt of successive points 1", 2", 3" is aimed, than the touch probe trajectory must be determined by 1', 2', 3' points.

Making the assumption that as a result of part exploring, several errors have been found, tool trajectory need to be modified. Modified trajectories are determined, described by 1', 2, 3', 4, 5', 6', 7' points. The parameters that determine trajectory modification are called correction parameters. For the parameter value determination it was successfully used neuronal network based techniques.

5. Design methodology integration, topological structure generation and control in a unitary theory, called mechanical construction topological geometry.

The result obtained on objective 2, 3 and 4 will be integrated in the topological geometry concept developed according to objective 1.

It is aimed a new unitary theory development to be based on own axis, theorem and method to solve a variety of issues.

6. Dimensional system proposal development, based on topological geometry of mechanical constructions.

Shape deviation evaluation, positioning and geometrical dimensions is defined by two standards: ISO/FDIS 1101:2000 (E) "Geometrical specification of the product – Geometrical tolerance – Form, orientation, position and beat tolerances"; ISO/TR 5460:1985 "Geometrical tolerances – Form, orientation, position and beat tolerances – Guiding principles".

A detailed investigation of these standards shows that there are several ambiguities so far that concern mathematics and physics.

Taking into account the fact, using the defined notions in these standards leads to both quantitative and quality errors of deviations of part compared to the theoretical part surface errors. In the some time it is excluded the possibility to locate a real surface between theoretical surfaces.

According to ISO/FDIS 1101:2000 (E) standard, for a cylindrical surfaces, tolerancing zone of cylindrical errors is

limited by two coaxial cylinders with the T difference of radius. In the some time, the standard shows that the surface cilindricity it is considered correct id the surface is herein between two coaxial cilynders with T difference of radius.

Depending on the position of the two cylinder axes and the radius value, it can be choosed in order that difference between radius to the lowest value possible.
In the figure 5 there are represented several cases, the first one is describing by two coaxial cylinders A_1 with axes z_1 and radius difference Δr_1, and the second case respectively represented by two coaxial cylinders A_2 and radius z_2 with radius difference Δr_2. The standard does not taking into account the way the two cylinders are identified, in order to compensate optimally the real surface errors, or if there are areas where error is overtaking cylinder surface. These ambiguities are the result of the fact that is no used proper numerical mathematic models to describe the surfaces.
The inference of the above stated ideas is that when calculating shape position and dimensional errors, according to the nowadays standards, there are several errors emerging and the source and nature cannot be identified.
Coordinate measurement machines for points measurement on the real surface and the interpretation provide several advantages compared with the classical measurement system, leading to the extend using of CMM.
However there are several shortcoming:
- CMM machines do not provide error definition displayed. Even the coordinate inspection machine manufacturers introduce their definitions of the deviations. This fact imposes the necessity of defining errors type based on mathematical models.
- It is stated that is possible to measure a considerable amount of points when exploring the surface and the increase of the point's amount will determine the precision increase of the surface. On the other hand it is the scale of the amount of points. It is not know exactly the trust when points are measured.
Consequently will be compulsory that a standard system to be defined accurately, defined on mathematical basis, the way the points coordinates to be interpreted on the real processed surface.

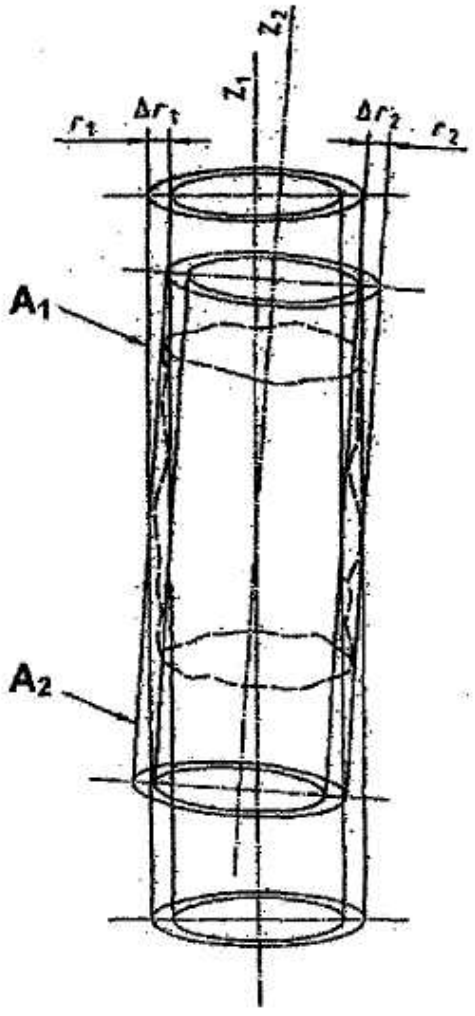

Fig. 5. *Cylinder that limit real surface*

We propose several key ideas to reach the specific objectives
1. The interface between two mechanical components is regarded though topological structure. Every component of the mechanical construction it is considered to be composed of mechanical component (link) and the interfaces (joint) interfacing to the rest of the assembly. The interfaces are composed of surfaces groups of mechanical components, groups corresponding to the surfaces on the assembly to form a pair shape and counter-shape.
2. Structural modeling of the geometrical construction is Davitt-Hartenberg **reference system based**
3. Dimensional control of parts processed is adaptive predictive based. This fact is performed using n parts previously processed providing the information needed to parameter correction of the n+1 part. This way the process parameters

is modifying mutinously, the error is dependent in such a way that error is dependent on the precision prediction.
4. The informatisation of a standards for dimensions, system based on the topological geometry of mechanical construction. It is the aim of the project to build a software product that is able to provide the deviations resulted after processing. These deviations will be regarded through topological approach of topological mechanical construction geometry.

7.3. Methodology of the research

The main objective of the project, in direct relations with the intermediary objective presented above, is determining the way the research from the point of view of technique, the devices and experimental methodology.

Objective 1

Development of the mechanical construction topologic geometry concept.

As presented, the topological geometry concept is a help for manufacturers and machine tool manufacturers in their effort to assure high quality of their small batch products.

using of this concept is based on gathering group points on the functional surfaces and than finding the theoretical surfaces to allow topological modeling, and than using of these modules in the generation models. To reach this aim it is necessary to follow the activies as depicted bellow:

1.1. Mechanical structure topological modeling. For every mechanical structure it is determined those topological structure composed of to be modeled with different techniques. Taking into account that every modeling technique has its own characteristics concerning generality and the computing capability to build the model, our aim is to establish recommendations for optimal modeling technique for different topological structure and different generating possibilities.

1.2. Functional construction topological geometry. Geometrical elements of a mechanical component can have a functional role. In the computing functional construction step it is to establish the functional role of each component than the classifying is performed of surfaces group. This step allows that the mechanical component to be described concerning functional topological structure.

1.3. Machining construction topological geometry. For each topological structure of a certain mechanical components it is computed parameters. These parameters are those model parameters describing the restrictions for all workpiece components to meet the functional role. As described in figure 2, not all workpiece parameters have a functional role. The gold of computing all parameters in the workpiece model is requiring a considerable amount of time. It is obvious better to compute and than model only those parameters that determines the functional mechanical component.

After functional parameters calculation it is performed the tolerancing, meaning that all parameters limits are computed.

1.4. Metrological construction topological geometry. As shown, part processing involves processing and inspection successive planning, allowing correction to be performed with an increase frequency than in the case when that was performed after processing. In order to complete corrections, it is compulsory parameter corrections computing. This is performed using neuronal network, as previous team member results confirmed, and is providing the correction parameter needed. Training the network with the results for first *n-1* workpieces, it can be obtain the correction parameters for the current *n* workpiece.

Will be acomplished research activities which presumes to determine the geometrical topology of various mechanical structures, based on points gathering from surfaces generated by machining on CNC. For points gathering will be used the 3D CMM which will be avaible in the *Mesurement and Surfaces Generation* laboratory. The result interpretation will be made by the MatLab softwre.

The activities will be realized by group formed by: Alexandru Epureanu (responsable), Nicolae Oancea, Virgil Teodor.

Objective 2

Every mechanical construction can be regarded as composed of several mechanical elements and interfaces. Analyzing the element depicted in the figure 6 can be distinguish mechanical element (shade color areas), areas with the role to assure the positioning of interfaces, and the interfaces areas (color areas), assuring the link of one component to another.

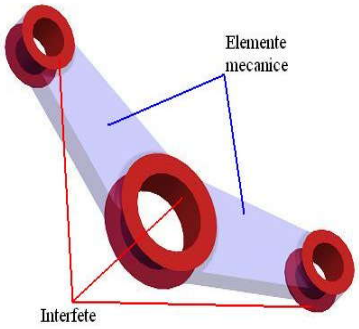

Fig. 6. *Mechanical elements and interfaces*

In order to design the mechanical structure topological geometry it is necessary to fulfill the following activities:

2.1. Mechanical structure topological geometry. In the figure 4 it is presented a mechanical component composed of two mechanical elements and three interfaces. It is noticed the fact that the functional parameters of two mechanical elements and angle between, and the functional parameters of the two mechanical components are relative positioning, diameters, and parallelism. The other parameters of geometrical construction do no determine the functional role of the component.
The similarity between mathematical model and the real object is described by the conformity parameters, equal to the functional parameters of the mechanical components.
2.2. Mechanical construction topologic structuring. Topological structure depicted in fig 4 it is characterized by the cylinder bore, the parallel characteristic between bore axes, parallelism of frontal surfaces reported to the bore axe.
The analytical model comprises both dimensions and the shape of every area and the positioning restriction described by mechanical element dimensions. Analytical model obtained will be mathematical relations composed of all topological structure parameters.
2.3. Dimensional and shape tolerancing of topological structure. Each one of the topological structure can rapport deviation, that if are kept in the limits restrictions, does not determine functional role of mechanical component. In tolerancing parameter variation limits are to be found. As shown before, it is preferable to analysis simultaneously parameters deviations than to limit every parameter deviation singularly. **It might be possible that singular limitation of every parameter to induce to wrong conclusion concerning workpiece tolerancing.**
The activities provided in this objective will be acomplished by: Virgil Teodor (responsible), Alexandru Epureanu, Nicolae Oancea.
Objective 3
Topological structure identification involves development of algorithm allowing functional elements identification of mechanical constructions as well as analytical expressing.
This will allow mathematical model building for the given construction, with the topological geometry concept in mind.
Research using Denavit-Hartenberg theory will be performed, in order to obtain transformation matrixes from one topological structure to another.
According Denait-Hartenberg theory moving from one coordinate system to another implies four successive steps: one rotation and translation along X axes, followed with a rotation along Z axes (or a second possibility with inverse order, one rotation and translation along Z axes, than a rotation and translation along *X* axes). In this manner we can state there are two methods to compute homogenous matrixes, which are different to the way interface and components are associated with the parameters.

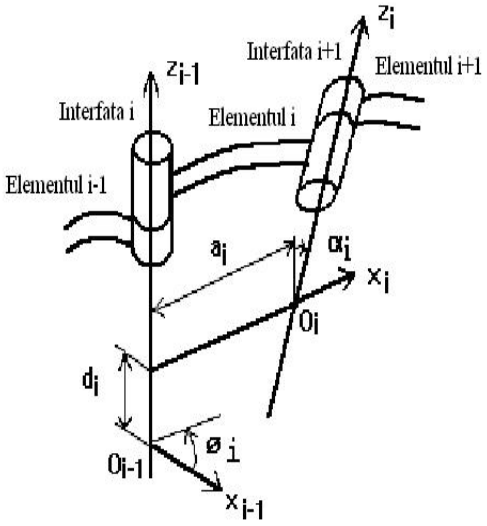

Fig. 7. *Coordinate system transfer*

The activities provided in this objective will be acomplished by: Virgil Teodor (responsible), Alexandru Epureanu, Marin Florin Bogdan, Ionut Popa.
Objective 4
Topological structure generation control is used for the control of tcomponent manufacturing to reduce deviations.
Research will be conducted to lead to soft product release for mechanical construction control and to output parameters correction needed.
It is expected that using neuronal based technique, trained with previous processing results, to result very correct data to establish parameters corrections.
For mechanical element control is necessary to identify all topological structure. This will be performed using identification techniques developed by research team members
4.1.Genetic algorithm for topological identification.
The research will aim building software products based on genetical algorithm to identify topological structures. It is well known that genetical algorithm can be used on wider area of issues, and it is expected the identification of complex topological structures. The some, this identification method is to allow accurate determination of correction parameters.

4.2. Topological identification based on neuronal model.
Training with neuronal network able to identify topological structure obtained on mechanical batch. As a result the neuronal network it is expected to identify topological structures and the parameters finding using previous parts processing.
4.3. Identification technique based on parameter circulation for topological structure.
Identification techniques based on parameters circulation was successfully used for singular surfaces. Several researches will be conducted to allow the development for identification, composed of assembly surfaces.
The research will be completed releasing software product to achieve topological structure identification based on group points explored on the component surfaces.
The research programm include some piece batch machinig on CNC machines and the inspection of the obtained surfaces by CMM and OMM.
The activities provided in this objective will be acomplished by: Virgil Teodor (responsible), Marin Florin Bogdan and Ionut Popa.
Objective 5
Design methodology integration, generation and control of topological structure control in a unitary theory, called mechanical construction topologic geometry.
5.1. Conceiving topological structure design methodology.
Taking into account the peculiarities of topological structure it is necessary to find new design methodology of mechanical components, to allow production and the control on the basis of topological geometry.
5.2. Conceiving of topological structure generation and control methodology.
We intend to buy high technology measurement devices for topological structures; as a result it is necessary that each technique to be analyzed and several recommendations will be stated.
Conceiving new design methods and dimensional control impose a new unitary theory called topological structures theory.
The results will be analised by dedicated software made by the research group formed by: Nicolae Oancea (responsible), Alexandru Epureanu, Virgil Teodor, Marin Florin Bogdan, Ionut Popa.
Objective 6
Will be follow a new standard elements proposal to define accurately, mathematically defined, the way of interpretation of group points on the processed surface The some, tolerancing value will be computed to evaluate fitting tolerancing. The next generation for standard proposed will be based on topological approach of mechanical constructions and can will be used for mechanical parts inspection.
A software will be build for automatic measured recognition of surfaces to evaluate the character of shape counter shape pair to form fitting.
The objective will be finished by publishing a book on a CNCSIS agreed publishing house.
The activities provided in this objective will be acomplished by: Alexandru Epureanu (responsible), Nicolae Oancea, Virgil Teodor.

7.4. Necessary resources:

7.4.1 Human resource

7.4.1.1. Project manager

7.4.1.1.1 Scientific competence of the project manager

There will be mentioned:
- Domains of competence and significant results, both theoretical and practical results
- Published scientific papers , in the last 5 years, in the domain of the proposed topic
- Scientific books in the domain (monographies, treaties, other books) ISI indexed, reviewed in international data bases, and/or published in acknowledged national and international publishing houses
- Patents/ discoveries/ essential contributions for knowledge development
- Products conceived/ achieved and revaluated in the socio-economic environment:
- Member in international journals editorial staff (ISI indexed or included in international data bases) or in aknowledged international publishing houses editorial staff
- National and international prizes awarded by professional associations and renowned institutions as a consequence of a demonstrable evaluating process

Competence field:
-Cutting process modeling on the machine-tools;
-Surface generation with cutting tools which work by;

-The surfaces generation methods study algorithmisation.
Significant results and contributions:
Member in the research team for *Scientific research grant nr. 373/2004* with S.C. PROMEX S.A;
Member in the research team for CNCSIS nr. 1041/2003 *Algorithmisation by solid modeling for the non-cylindrical polyform surfaces study*;
Member in the research team for CNCSIS nr. 1027/2003 *A new algorithm for the enveloping surfaces study, with applications in the spiroidal gear sintesis*;
Member in the research team for CEEX 22, action 4, *The sintesis of new technics for profiling system kinematics of generating tools* ;
Member in the research team for CEEX 23, *Information and comunication based techniques for dimensional control of a new reconfigurable machining systems*;
Significant paper:
[1] Epureanu, Al., **Teodor, V.,** Dima, M., Oancea, N., *A Reconfigurated Rack-Tool for Generation of Gears*, International Journal of Advanced Manufacturing Technology, ISSN 0268-3768 (Print) 1433-3015 (Online), DOI 10.1007/s00170-008-1401-0;
[2] **Teodor V.,** Epureanu A., Cuzmin C., *Method for Identification of Geometric Feature Family Based on Genetic Algorithm and Neural Approach* Procedeeings of WSEAS EUROPEAN COMPUTING CONFERENCE, Athens, Greece, September 25-27, 2007;
[3] Cuzmin C., **Teodor V.,** Oancea N., Marinescu V., Epureanu A., *Dimensional dynamics identification of reconfigurable machine tools*. Proceedings of WSEAS European Computing Conference, Athens, GREECE, September 25-27, 2007;
[4] Epureanu A., **Teodor V.,** *On-Line Geometrical Identification of Reconfigurable Machine Tool using Virtual Machining*, Publicată în revista Enformatika, vol. 15, SPANIA, 2006, ISBN 975-00803-4-3;
[5] Epureanu A., **Teodor V.,** Oancea N., Banu M., Marinescu V., *Method for On-Line Identification of Reconfigurable Machine-Tool Geometry Based on a Topological Neural Approach*, Journal of Manufacturing Science and Engineering (sent in order to print).

7.4.1.1.2. Managerial competence of the project manager

There will be mentioned:

- National and/or international research projects and contracts awarded by competition as principal investigator (there will be specified – the title, the awarding year, the financing source, the amount granted) ,and the results disemination (ex. Articles in ISI indexed journals and/or included in international Data Bases
- Setting up (coordinating) research laboratories, centres and/or institutions.

The project manager was member of research team for the following projects:
-Member in the research team for *Scientific research grant nr. 373/2004* with S.C. PROMEX S.A;
-Member in the research team for CNCSIS nr. 1041/2003 *Algorithmisation by solid modeling for the non-cylindrical polyform surfaces study*;
-Member in the research team for CNCSIS nr. 1027/2003 *A new algorithm for the enveloping surfaces study, with applications in the spiroidal gear sintesis*;
-Member in the research team for CEEX 22, action 4, *The sintesis of new technics for profiling system kinematics of generating tools* ;
-Member in the research team for CEEX 23, *Information and comunication based techniques for dimensional control of a new reconfigurable machining systems*.

The project manager is graduate of „**Senior Manager**" course on frame of **Research management** programm, developed by **Education and Research Minister** in year 2006.

7.4.1.2. Research team

List of the research team members: (Without the project manager)

Crt. No.	Surname and first name	Year of birth	Didactic /scientific title *	Doctorate * *	Signature
1	Epureanu Alexandru	1942	Professor	Yes	
2	Oancea Nicolae	1943	Professor	Yes	
3	Marin Florin Bogdan	1981	Researcher	Candidate for s doctor's degree	
4	Popa Ionut	1980	Researcher	Candidate for s doctor's degree	
5					

* **At "Didactic /scientific title"** fill with one of the variants:
Professor / Docent / Lecturer / Assistant / SR I / SR II / SR III / Researcher

** **At "Doctorate"** fill with one of the variants**: YES /NO / Candidate for a doctor's degree**

7.4.1.2.1. Experienced researchers : (Without the project manager)

There will be mentioned:

- Previous experience of each team member in the domain of the proposed topic
- Domains of competence and significant results – documented both by theoretical and practical results
- Significant papers published , in the last 5 years, in the domain of the proposed topic
- Modalities of results revaluation/dissemination – publications, patents, participations in conferences
- Projects obtained by the team members – title, financing level, financing source, duration

Epureanu Alexandru

A) Previous research in the proposed project field

He developed 10 previous research programs concerning adaptive dimensional control of manufacturing system, simulation methods, virtual production and modeling for embedded manufacturing system and embedded manufacturing system.

B) Research areas and most relevant results achieved

Main competence fields : a) processing precision; b) processing econometrics; c) machining system stability; d) adaptive optimal predictive machine control; e) cutting and rolling processes instability; f) reconfigurable system; g) holonic system; h) embedded manufacturing system.

Most relevant theoretical results in the proposed project field:

1. *Development of new optimizing method of cutting processes* underline the idea that the minimum cost cannot be reached simultaneously with productivity maximum level; the optimizing criteria is the market success of the manufactured product, considered through selling product price. The conclusion is that the margin can be maximized if the products selling price is undermine the manufacturing price, by maximizing productivity, whereas the products with the selling price close to that of production are manufactured with the minimum.
2. *Machining system stability theory* is considering the inertia force importance in the instability phenomenon increasing; two basic phenomenons are taking into account, static stability and dynamic stability. The some it is draw the line between instability phenomenon emerging during a cutting cycle, called primarily instability, and instability phenomenon emerging when the process is represented by several cutting cycles called regenerative process. It is of major importance to underline that in the cutting process the dynamic processes instability cannot emerge only if signal length is in the critical domain.
3. *Diagnosis and analysis process methodology,* based on the concept of multi function of machine tool, that of processing machine and measurement device. Integrating measurement capability to the machine tool, self deviation of the system can be separated by those generated by the thermo-mechanical field of the machine This methodology, is representing the basic approach for dimensional control of the machine tool and aims to develop the diagnosability idea as feature of reconfigurable machine tool.

4. *Processing adaptive predictive control theory,* is taking into account that the processing of every workpiece in a batch can provide informations concerning machine tool behavior. If these informations are no to be ignored (as present time), but computed to identify on-line the machining system, than the prediction of behavior it is possible.
5. *Machining system optimal intelligent control theory* is considering the machine tool monitoring, storing the information needed in a data base, interpreting these informations in knowledge and using of these to identify system, to apply the model obtained for optimizing the system.
6. Reconfigurable machine tool – concept and methodology – it is a strategic direction of development of machine tool, based on the idea of minimizing the investment not used in the manufacturing the reconfigurable system is to assure combining the advantages of dedicated system to those of flexible, and for a further extend the concept, to develop holonic manufacturing system It is expected first industrial reconfigurable manufacturing system to be released around 2020..
Most relevant practical results:
1) development of a new generation of reconfigurable system with the feature of intelligent dimensional control; 2) a new embedded system class – manufacturing embedded intelligent system; 3) reconfigurable inspection robot; 4) Reconfigurable numerical control system.

C) Most relevant scientific paper Publisher in the proponed Project area in the last 5 years:

1. Alexandru Epureanu, Virgil Teodor, Mircea Dima and Nicolae Oancea, *A reconfigurated rack-tool for the generation of gears,* The International Journal of Advanced Manufacturing Technology, jan. **2008**, p.56-61 **(ISI)**.
2. Alexandru Epureanu, Virgil Teodor ,*On-Line Geometrical Identification of Reconfigurable Machine Tool using Virtual Machining*, Enformatica, vol. 15, SPANIA, **2006**, ISBN 975-00803-4-3 **(ISI).**
3. George C. Balan, Alexandru Epureanu, *The monitoring of the turning tool wear process using an artificial neural network*, The 2nd IPROMS Virtual International Conference on Intelligent Production Machines and Systems", Cardiff, UK, iul. **2006 (ISI).**
4. Banu M., Naidim O., Epureanu A., *Artificial Neural Network applied to the Extrusion Die Wear Prediction*, International Journal of Materials and Product Technology, ISSN (Online): 1741-5209 - ISSN (Print): 0268-1900, UK, **2006 (ISI).**
5. Cuzmin C., Teodor V., Oancea N., Marinescu V., Epureanu A., *Dimensional dynamics identification of reconfigurable machine tools*. Proceedings of WSEAS European Computing Conference, Athens, GREECE, September 25-27, **2007**, **(ISI).**
6. Teodor V., Epureanu A., Cuzmin C., *Method for Identification of Geometric Feature Family Based on Genetic Algorithm and Neural Approach* Procedeeings of WSEAS EUROPEAN COMPUTING CONFERENCE, GREECE, September 25-27, **2007 (ISI)**.
7. BALAN, C. George; EPUREANU, Alexandru; POPA, Rustem & CONSTANTIN, Ionut, *CHATTER DETECTION USING THE MAIN CUTTING FORCE*, published in The 18th INTERNATIONAL DAAAM SYMPOSIUM "Intelligent Manufacturing & Automation: Focus on Creativity, Responsibility and Ethics of Engineers", Croatia, 24-27th October **2007**, **(ISI).**
8. Oancea ,N, Epureanu, Al., *A new Method for Cutting Tools Design,* Proceedings of ASME Design Engineering Technical Conferences, September 10 –13, Baltimore, Maryland, USA, **(ISI).**
9. Andrei, L., Andrei, G., Epureanu, Al., Oancea, N., Walton, D., *Numerical simulation and generation of curved face width gears*, **2002**, International Journal of Machine Tools & Manufacture, Pergamon, 42, 1-6, UK, ISSN 0890-6955 **(ISI)**.

D) Dissemination modalities: papers, pattents, conferences

Published scientific papers -**202** scientific papers, Publisher in journals and conference papers in Romania and other **17** countries (France, Italy, Germany, Holland, U.K., Spain, China, Rep. of Moldova, Ukraine, U.S.A, Canada, Croatia, Australia, Sweden, Switzerland, Belgium, and Hungary**).**

Scientific books in the field -**18** books, **5** published abroad

Patents -**18**

Conceived products:

1) sinusoidal driving wheel; 2) Cylindrical ***gearings with curve teeth***; 3) ***frontal couplings with curve teeth for car gears***; 4) ***flexible cages for bears***; 5) ***machines for cutting flanges*** ; 6) editor and reviewer for – Annals of "Dunarea de Jos" University Galati. ***IT based technology for dimensional control***, implemented to FICEP-20.36-NT, FICEP-16.34- NT, FICEP-803-PN, VERNET-PG-116 S machine at S.C. CELPI S.A. Bucharest company ; 7) ***Adaptive dimensional control technology***, implemented in FICEP-1415 DCA and FICEP LPA 15. machine tool at S. C. EDIL-MECANICA S.A. Filipestii de Padure company; 8) ***Predictive dimensional control technology***, in FICEP 1415 DCA , FICEP 2036 NT, VERNET-PG-137 machine at Electromontaj Bucharest company. 9) R***econfigurable numerical control system***, implement in two prototype machine tool (frontal lathe and mill machine), with the following characteristics: - reconfigurable interface module; -OPC server for information management of machine reconfigurable system control; -reconfigurable machine tool control (PLC, I/O analogical module).

E) International and national research project:

He won 35 research projects as manager director, some are listed bellow

Nr. crt.	Project title	Year	Financing	Project value
1.	Robot Based Dimensional Control in Manufacturing	1996	European Commission	185.000 Euro
2.	Quality Assurance in Manufacturing	1997	European Commission	285.000 Euro
3.	Virtual Intelligent Forging	2004	European Commission	115.000 Euro
4.	IT based techniques for adaptive intelligent dimensional control for the next generation manufacturing system	2005	MCT	300.000 RON
5.	Simulating, modeling and manufacturing methods for virtual manufacturing and based on It technology and dedicated communication for the reconfigurable manufacturing system	2005	MCT	200.000 RON
6.	A new embedded system class- embedded intelligent manufacturing system	2006	MCT	200.000 RON
7.	Integrated technology manufacturing for processing thin sheets TIFF/TMS	2006	MCT	200.000 RON

F) Other relevant results:

Laboratory centre or research institute establishment:

a) Establishment and leading for 10 years *of Central Research laboratory and learning of university*;

b) establishment and leading of *Manufacturing science and engineering Research Center at "Dunarea de Jos" University Galati*;

c) establishment and leading of computer Aided *Design Research Center Laboratory* at Mechanics faculty - *"Dunarea de Jos" University Galati*.

PhD Scientific Advisor for: **12 PhDs students**

Previous PhD Scientific Advisor for: **14 finished thesis**

Managerial competence: after 1990, **five dean mandates**, pro-rector and rector

Oancea Nicolae

Main competence fields: a). cutting tools optimisation in order to increase the performance; b). reciprocally enveloping surface study research methodology c). metal alloy cutting; d). total quality basics.

Published scientific papers -214 scientifica papers on volumes of scientific conferences or magazines from Romania and another 7 contries (Bulgary, Greece, Italy, Israel, Rusia, SUA, Hungary**).**

[1] **Oancea, N.,** Oancea, V.G., *Geometrical Modeling of Surface Generation Through Wrapping*, Journal of Manufacturing Science and Engineering, Vol. 119, November 1997, pp. 829-824, 1997;

[2] **Oancea, N.,** *Methode numerique pour l'etude des surfaces enveloppes*, Mechanism, Machine Theory, Pergamon, vol. 31, no 7, p. 957-972, 1996;

[3] Teodor,V., **Oancea, N.,** Baicu, I., Oancea,V.G., *The In-Plane Trajectories Method with Applicatios in Surfaces Generation*, The 8th World Multi-Conferace on Systemics, Cybernetics and Informatics. Proceedings Vol. V, Computer Science and Engineering ,Orlando ,USA, p.318-321, ISBN 980-6560-13-2, 2004;

[4] **Oancea, N.,** Teodor, V., Oancea, V.G., *A New Numerical method for Cutting Tool Design*, Proceedings of The 3rd International Conferece on Computing, Communication and Control Technologies, Austin, Texas, Vol. II, ISBN 980-6569-45-0; ISBN:980-6560-47-7, p.275-278, 2005;

[5] Teodor, V., **Oancea, N.,** Dima , M., Oancea, V.G., *Discontinuity Points on Cutting Using The Virtual Extension Method*, The 10th World Multi-Conferace on Systemics, Cybernetics and Informatics. Proceedings, Vol. IV, Computer Science and Engineering ,Orlando ,USA, p. 239-244, ISBN 980-6560-65-5, ISBN 9806560-69-8 (Volume), 2006.

Scientific books on speciality field -25 books.

Inovation licences -11 licences

Member in the editorial team of "Dunarea de Jos" University from Galati.

7.4.1.2.2. Early stage researchers

There must be a clear and credible delimitation of their part in carrying on the research activites in the project, specifying the title of their doctoral dissertation (if possible).

In frame of research project will be involved to candidates for doctoral degree which will developed research capabilities in the proposed domain, in principle in the software products in this way to assure the knowledge transmission.
The early stage researchers may developed in this way, research abilities in the proposed domain.

Marin Florin Bogdan , candidate for doctoral degree , scientific leader prof. dr. ing. Alexandru Epureanu. Doctoral thesis title is ***Reconfigurable machining systems leadership***. Will be involved on the 3, 4 and 5 objectives by the folloing actions: 3. *Topological structures identification*, 4.1. *Topological identification using genetical algorithms*, 4.2. *Topological identification using neural network*, 4.3. *The identification technique based on parameter circulation extension on the topological structures identification*, 5.1. *Design methodology for topological structures* 5.2. *Generation and control methodology for topological structures*.
The project objectives in which is involved are chapters from the doctoral thesis of the early stage researcher.
Obiectivele din proiect la realizarea carora participa constituie capitole din teza de doctorat a doctorandului.

Popa Ionut , candidate for doctoral degree , scientific leader prof. dr. ing. Nicolae Oancea. Doctoral thesis title is ***S.E. Compresion***. Will be involved on the 3, 4 and 5 objectives by the folloing actions: 3. *Topological structures identification*, 4.1. *Topological identification using genetical algorithms*, 4.2. *Topological identification using neural network*, 4.3. *The identification technique based on parameter circulation extension on the topological structures identification*, 5.1. *Design methodology for topological structures* 5.2. *Generation and control methodology for topological structures*.
The project objectives in which is involved are chapters from the doctoral thesis of the early stage researcher.

7.4.2 Other resources

7.4.2.1. Financial resources

All the direct expenses are detailed (staff, logistic, mobilities costs)
There must be very clear the degree of implication in the research project of each member in the team (the share from a full time work program)

Staff expenses:
Mobilities: Are provided participations on internal (3 papers on each year) and external (2 papers on each year).

Crt. no.	Surname, first name	Function	Full norm wadges Euro	Percent from full norm	Month number	Wadges from project Euro
1	Teodor Virgil	Lecturer	2125	11%	36	8398
2	Epureanu Alexandru	Professor	3400	11%	36	13793
3	Oancea Nicolae	Professor	3400	11%	36	13793
4	Marin Florin Bogdan	Candidate for PhD	1487	11%	36	5997
5	Popa Ionut	Candidate for PhD	1487	11%	36	5997
			Total wadges from project			47978
			Employer contributions			16272
			Staff expnses			64250

Logistic costs:
- MILL 55 with CNC milling center in value of 35000 €;
- Type XYSTUM machine in value of 30000 €;
- Type PC-DMIS PRO-Vision profile projector in value of 25000 €;
- data processing software;
- materials.

7.4.2.2. **Available infrastructure** (the quality of the existent research infrastructure)

There will be made a distinction between the infrastructure of ICT and the rest of the infrastructure (equipments and facilities for experimentation, belonging to the institution or available by means of cooperation with other institutions)

IT substructure:

- For numerical modeling: laboratory, including Pentium Dual Core computers and AUTO-CAD 2000 license;
- Software - ALGOR Soft DMC Lab Plus;
- Specialized software for reciprocally enveloping surfaces study by solid modeling method (Dunarea de Jos University of Galati).

Research substructure:

- Universal and numerical commanded machine-tools;
- Hottiger Baldwin Messtechnik transducter;
- 3D measuring device: MICROSCRIBE 3DX, Immersion Corporation - U.S.A.;
- Device for roughness measuring: SURTRONIC 3+;
- High speed machining device;
- Adaptive dimensional control system for CNC machine-tools;
- CNC turning machine-tool with 8 tools store;
- Reconfigurable turning machine;
- Force and torque transducer;
- Spider acquisition device.

8. Project management:

8.1. Work plan. Obiectives and activities

Year *	Goals (Name of the obiective)		Associated activities
2008	1	The mechanical structures topological geoemtry concept developmet – fully documetation in the new concept problematic	**1.1.** Fully information regarding the topologcal modeling of surfaces by bibliographic research **1.2.** Documentation regarding the approach on surfaces modeling by genetical algorithms, neural netork and parameters circulation
2009	1	The topological geometry concept development	**1.3.** Mechanical structures topological modeling **1.4.** Functional structurea topological geometry **1.5.** Technological structures topological geometry **1.6.** Metrological structures topological geometry
	2	Topological structures identification	**2.1.** Mechanical structures topological geometry description **2.2.** Mechanical structures topological clasification **2.3.** Dimensional and form tolerancing of topological structures
	3	Design principles for topological design of mechanical structures	**3.1.** Design principles for topological design of mechanical structures
2010	4	Generation control of topological structures for error compensation	**4.1.** Topological identification using genetical algorithms **4.2.** Topological identification using neural networks **4.3.** The parameters circulation identification technique extension at topological structures identification
	5	Design, generating and control methods integration on a unitary theory, the mechanical structures topological geometry	**5.1.** The design methodology for topological structures **5.2.** Conceperea metodologiilor de generare si control al structurilor topologice
2011	6	Standards elements proposal for mechanical structures topological geometry	**6.1.** Standards elements proposal for mechanical structures topological geometry

8.2. Project feasibility (having in mind the human resource (experience) and other resources involved into the development of the based on previous confirmed capacity project

Is assured by following elements:

1. In the research staff was acumulated a scientific experience in surface design, generation and control domain.
2. The project manager have 14 years experience in mechanical structures design (8 years in research-design institution from industry). Also the manager have a grant in the frame of contract CEEX 23, *Information and comunication based techniques for dimensional control of a new reconfigurable machining systems* .
3. The experienced researchers involved in this project have 30 years experience in the theoretically and practically domain of surfaces generation and control.
4. The early stage researchers are PhD students whom doctoral thesis chapters are objectives from this project. Also, the early stage researchers are good programmers with very well apreciated results.
5. Exist the matherial basis which allow to appoach the experimentals aspects of the proposed programm. The expenses don't excend the financial resources of the proposed programm;
6. The research staff know very well the results obtainde in this domain in Europe and USA;

The staff contribution in the proposed domain allow us to say that the project is fesiabile and that the finally of this project by algorithmics and software may be realised.
The doctoral thesis of the early stages researchers will be finished in the project time.

8.3. Results dissemination plan

The research staff propose the valorification of results by:
-partial research raport (year I) – 1 issue also at "Dunarea de Jos" University from Galati library;
- partial research raport (year II) – 1 issue also at "Dunarea de Jos" University from Galati library;
- partial research raport (year III) – 1 issue also at "Dunarea de Jos" University from Galati library;
-research raport to the sponsor partener;
-yearly publishing of 3 (three) papers on magazines indexed on international data base;

-publishing of a book in the project domain at a CNCSIS agreed publishing house;
-participation with papers at international conferences (World Multi-Conference on Systemics, Cybernetics and Informatics, World Scientific and Engineering Academy and Society International Conference or similarly);

8.4. If there areapplied research activities, please specify those activities and the allocated budget

8.5. Measures provided in order to respect the research

A. In order to respect the research norms will be respected the folloing:

1. the clear delimitation of activity for each member of research team;
2. the program manager will not allow that in the list of authors for a paper to will be inserted persons which are not collaborated at published results;
3. the name of project manager will be referred only on these papers where he have a significant contribution recognized by all the research team members;
4. the contribution of a member of research staff will be recognised only if its consist on ideas and actions and not only in logistic help;
5. the program manager will guard that the scientific information take by another papers to be clear marked as belongs to the persons which are the authors.

Because the programme manager applied these currently in its activity, it's presumed to make this in the frame of this project.

B. The copyright for the project results will be attributed as following:

a) scientific articles and presentations on conferences - belongs entirely of the authors;

b) the innovation licences will be give to "Dunarea de Jos" University of Galati;

c) the authors staff from **a** and **b** points may include authors that are not members in the project but which have a significant contribution in the results obtaining;

C. The whole project will be subordinate to concept do not aggress the environment.

D. Conformably to law 206/204 they are unacceptable the following:

a) hiding or replacement of the undesired results;
b) manufacturing of results;
c) replace the results with false data;
d) conclusions distortion;
e) plagiarize of others authors;
f) to distortion the results of another researcher;
g) to not correctly mention the author of a paper;
h) to insert false informations in the appliances or grants;
i) to hide the interests conflicts;
j) embezzlement of research funds;
k) recording of the known erroneously results or not recording of the undesired results;
l) to not inform the staff on the wages, copy rights, sponsors and partnership;
m) to not respect the confidentiality and to be unfairly in evaluation;
n) to publish or to require repeated funds for same results as new scientific results.

E. Contradictory data, differences on experimental or practical conceptions, different on data interpretation different on opinion are specifically for research and development and are not deviations from the fair behaviour.

CHECKING LIST

- The project manager is full time employed in the institution which proposes the project;
- The project manager has the PhD degree;
- The proposed project has obiectives and actions to be achieved during a period of 36 months;
- All the requested Annexes have been filled;
- The budget has been filled in “euro”;
- The financing request is signed by the authorized persons from the host institution.