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DESIGN OF LATHE-BLADE MECHANISM WITH BASIC KINEMATICS BLOCKS USING METHODOLOGY OF DUAL-VECTOR ALGEBRA

Dr. Sc. Kastriot A. Buza
Faculty of Education
Address: Agim Ramadani, nn 10000 Prishtina
Kosova

Dr. Sc. Shaban A. Buza, Dr.Sc.Ismajl Gojani,
Dr.Sc.Arbnor Pajaziti, Dr.Sc.Fevzi Radoniqi
Faculty of Mechanical Engineering
Address: Kodra e Diellit, nn 10000 Prishtina
Kosova

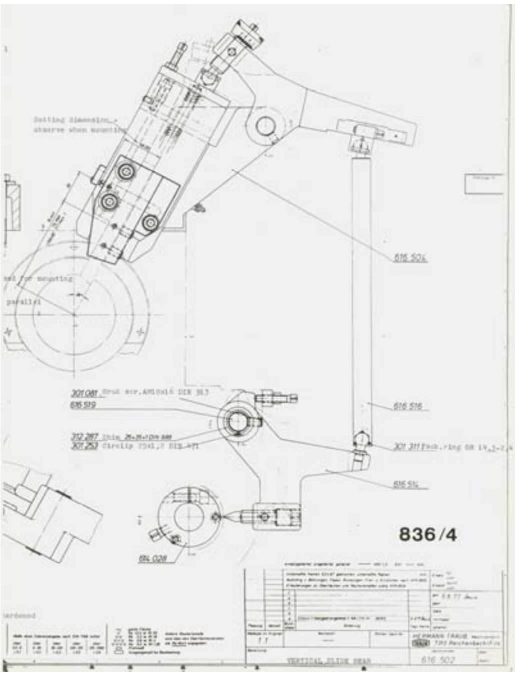
ABSTRACT
The methodology of dual-vector algebra for design of mechanisms was elaborated in this paper.
The lathe – blade mechanism was designed using basic kinematics blocks. For all types of kinematics blocks the characteristic code of screw motion with respected illustration has been given.
Screw motion using dual-vector algebra in its general presentation includes dual number, direction and position vector of motion that fulfils topological synthesis during the mechanisms design process.
Motion characteristic code includes motion, continuity, linearity and direction of kinematics blocks.
Key words*:* Basic kinematics blocks, input motion, output motion, screw motion, motion characteristic code.

1. INTRODUCTION

The rotating shafts of the electric motors are manufactured by lathe with copier.
The turning process is realized through a complex mechanism which transmits motion from the copier to the blade, Figure 1 [1,2]. The lathe contains the mechanism which rotational motion at input transforms into translation motion at output. It means that copier performs rotational motion and blade realizes translation motion [1,2,3].
Input and output data are not linear and not interchangeable [1,2].
Mechanism design can be realised using several methodologies [1,2,7,8,9].
The methodology the algorithm that presents the mechanisms design using Basic Kinematics Blocks goes through four basic phases: (a) Motion Specifics, (b) Functional Synthesis, (c) Topological Synthesis and (d) Dimensional Synthesis [1,2].In the motion specifics and functional synthesis the Motion Characteristic Code is taken into consideration, while at topological synthesis the methodology of dual-vector algebra is used [1].

2. METHODOLOGY OF DUAL-VECTOR ALGEBRA FOR DESIGN OF BLADE-COPIER MECHANISM

For using dual-vector algebra on synthesis of multi-bar mechanism blade-copier the first step is to identify Motion Characteristic Code (MCC). Motion Characteristic Code including data is used to determine the type of motion, continuity, linearity and direction of building blocks [1,4,5,6,7].



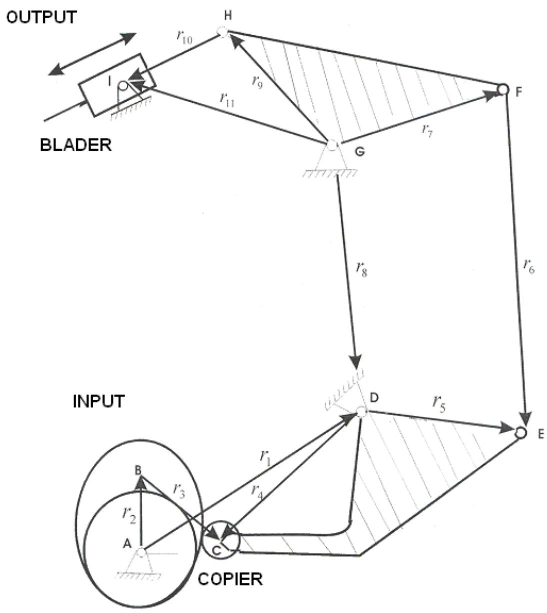


Figure 1. Lathe with copier-blade mechanism

Figure 2. Vector loop for alternate multi linkage copier-blade mechanism

Second step is identification of basic kinematics blocks for the input and output (rotational) motion of the first kinematic pair (couple), where the condition is met by the Mechanisms with Cylindrical Cam [1]. While, for the second kinematic pair with rotation as an input motion and translation as output, the identified basic kinematic blocks are: Crank-Slider Mechanism, Six-Bar Linkage Mechanism, Mechanism with Cam and Mechanism with Cam-Wedge [1].

In the third step, after identification of the basic kinematic blocks, the screw motion of the first kinematic pair (Rotation-Rotation) was connected with screw motion of the second kinematic pair (Rotation-Traslation) obtaining four multi-bar mechanisms.

Analyzing all possible combinations functionally and constructively based on original mechanism fig.1, it was concluded that Mechanism with Cylindrical Cam and Six-Bar Mechanism fulfills the criteria, fig.2 [1,4,5,6].

In Figur 3 and Figure 4 the Mechanism Cylindrical Cam-Follower and Six-Bar dwell linkage with their Motion Characteristic Code in output and input and screw motion at input and output are presented.

MOTION CHARACTERISTIC CODE (MCC) for Cylindrical Cam-Follower	
INPUT	**OUTPUT**
0-Rotation 0-Continuous 0-Linear 0-Unidirectional	0-Rotation 0-Continuous 1-Nonlinear 0-Unidirectional

$$\hat{S}_I = (\theta_I \quad + \quad \varepsilon \cdot 0)\left[\begin{Bmatrix}0\\0\\1\end{Bmatrix} + \varepsilon\begin{Bmatrix}0\\0\\0\end{Bmatrix}\right].$$

$$\hat{S}_O = (F(\theta_I) \quad + \quad \varepsilon \cdot 0)\left[\begin{Bmatrix}0\\0\\1\end{Bmatrix} + \varepsilon\begin{Bmatrix}0\\0\\-D\end{Bmatrix}\right].$$

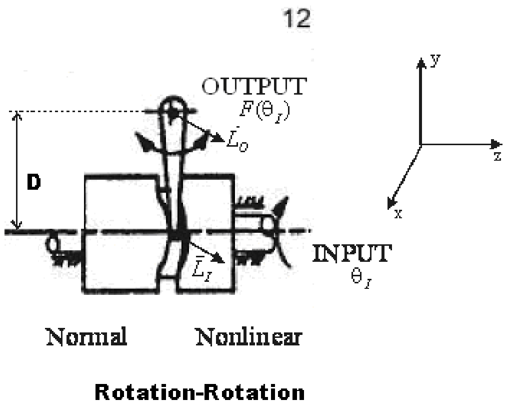


Figure 3. Cylindrical Cam-Follower

MOTION CHARACTERISTIC CODE (MCC) for Six-bar dwell linkage	
INPUT	**OUTPUT**
0-Rotation 0-Continuous 0-Linear 0-Unidirectional	1-Translation 0-Continuous 1-Nonlinear 1-Bidirectional

$$\hat{S}_I = (\theta_I \quad + \quad \varepsilon \cdot 0)\left[\begin{Bmatrix}0\\0\\1\end{Bmatrix} + \varepsilon\begin{Bmatrix}0\\0\\0\end{Bmatrix}\right].$$

$$\hat{S}_O = (0 \quad + \quad \varepsilon \cdot D(\theta_I))\left[\begin{Bmatrix}0\\1\\0\end{Bmatrix} + \varepsilon\begin{Bmatrix}0\\0\\D\end{Bmatrix}\right].$$

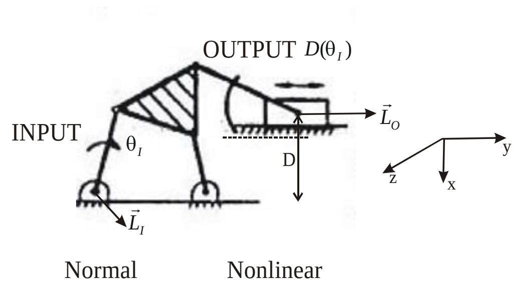


Figure 4. Six-bar dwell linkage

3. CONCLUSIONS

Based on analysis of the synthesis methodology of the mechanisms using dual-vector algebra at blade-copier mechanisms, representation of input-output of the screw motion and motion characteristic code, can be concluded that:

- Through dual-vector algebra the topological synthesis for mechanisms design can be used;
- The determination of the screw motion at input and output using dual-vector for basic kinematic blocks presents a good base for synthesis of the high order mechanisms;
- The methodology of dual-vector algebra enables realization of a high number of alternate solutions on mechanisms design;
- Many alternate solutions for multi-bar blade-copier mechanism design has been obtained;
- The best solution based on criteria of functionality, geometry and motion has been chosen.

4. REFERENCES

[1] Buza K.: Kontribut sintezës së mekanizmave duke shfrytëzuar algjebrën e vektorit-dual, Disertacioni i doktoraturës (Doctorate thesis), Prishtina, 2006.

[2] Buza K.: Disajnimi automatik i mekanizmave me ndihmen e programeve aplikative, Punim magjistrature (Master work), Prishtina, 2003.

[3] Buza K., Pirraj B., Gojani I., Pajaziti A., Anxhaku A.: General Matrix Model at the Second Level of Automatic Synthesis Procedre of the Mechanisms, Proceedings of the 10th International Research/Expert Conference "Trends in the Development of Machinery and Associated Technology", TMT 2006, Barcelona –Lloret de Mar, Spain, 11-15 September, 2006, pp. 785-788.

[4] Buza K., Gojani I., Pajaziti A., Anxhaku A.: Screw Motion of Some Basic Kinematic Blocks Through Dual-Vector Algebra, Proceedings of the 11th International Research/Expert Conference "Trends in the Development of Machinery and Associated Technology", TMT 2007, Hammamet, Tunisia, 5-9 September, 2007, pp. 891-894.

[5] Buza K., Gojani I., Pajaziti A., Anxhaku A.: Motion Characteristic Code at the Screw Motion for Some Basic Kinematics Blocks Using Dual-Vector Algebra, Proceedings of the 12th International Research/Expert Conference "Trends in the Development of Machinery and Associated Technology", TMT 2008, Istambul, Turkey, 26-30 August, 2008, pp. 1005-1008.

[6] Buza K., Gojani I., Pajaziti A., Buza Sh., Anxhaku A.: Comparison of First Level Motion Transformation Matrix and Operational Constraint Vector with Motion Characteristic Code at the Mechanisms Design, Proceedings of the 13th International Research/Expert Conference "Trends in the Development of Machinery and Associated Technology", TMT 2009, Hammamet, Tunisia, 16-21 October, 2009, pp. 601-604.

[7] Moon Y.-M., Kota S.: Automated synthesis of mechanisms using dual-vector algebra, Mechanism and Machine Theory 37, pp.143-166, Ann Arbor, 2002

[8] Y.-M.Moon, *Reconfigurable Machine Tool Design: Theory and Application*, Ph.D. Dissertation, The University of Michigan, Ann Arbor, Michigan, 2000.

[9] Waldron K. J., Kinzel G. L.: Kinematics, Dynamics and Design of Machinery, Second Edition, John Wiley and Sons, USA, 2004.