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SUMMARY OF PROFESSIONAL ACCOMPLISHMENTS CONCERNING RESEARCH, EDUCATIONAL AND ORGANIZATIONAL ACTIVITIES

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CURRICULUM VITAE

Maciej Kuchar Ph.d.

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Education and scientific degrees:

1992 MSc Technical University of Lodz, Faculty of Mechanics,
2002 PhD Technical University of Lodz, Faculty of Textile Engineering and Marketing

Employment:

1991 – 1993, Production, Service and Trade Company „Dur-Abica" - spare parts manager

1993 – 1996, Lodz University of Technology, Institute of machine design - assistant

1996 – 1998, Production and service Company Pro-Tech Sp. Z o.o., - designer

1998 – 2003, Lodz University of Technology, Institute of machine design - assistant

2004 - 2011 Lodz University of Technology, Department of construction and maintenance of machinery - adjunct

2011 - 2014 Lodz University of Technology, Department of Vehicles and Fundamentals of Machine Design - adjunct, from 2014 until now - lecturer

1. SCIENTIFIC, RESEARCH AND PROJECT ACTIVITIES

1. 1. Scientific, research and project activities before PhD

I graduated in 1992 from the Faculty of Mechanical Engineering obtaining a Master of Science degree with a specialization in textile machinery. The topic of my master thesis was: ***Supply system of a flat card machine*** and it was aimed at developing the construction of textile carding machinery.

During my studies I gained first practical experience concerning construction and operation of vehicles, while working in an automotive company as a specialist for spare parts between 1991-93.

I started working at Lodz University of Technology in 1993 as an academic teacher in the position of an assistant at the Institute of Machine Design. I dealt with the field of magnetic bearings, supervised by prof. J. Burcan. I am a co-author of a stand for testing passive magnetic thrust bearings. I conducted research on the dynamics of bearings, which resulted in delivering a lecture at the Fourth Conference of Unconventional Bearing Centers in 1999. I designed and executed a magnetic thrust bearing which constituted an element of a stand for testing slide bearings, at the commission of Wroclaw University of Science and Technology.

In addition to scientific and educational activities, I also won practical engineering experience in energy industry. I worked as a designer of energy systems at a design office in 1996-98. I was involved in design work, as well as measurements and control activities related to thermal technology. I won SEP (Polish Electricians Association) permissions for measurement and control works in the field of power equipment. I am the author or co-author of several projects including: high-pressure pipelines, flues and large-scale heating fittings, not only for Łódź Power Plant.

In cooperation with the Institute of Architecture of Textiles of Lodz University of Technology since 1999, I have been conducting research works concerning weaving machines in the area of dynamics of dobby mechanism of the loom, supervised by prof. J. Słodowy. The object of my research was dobby mechanism in which the crank or cam mechanism was replaced with resonance mechanism. In this mechanism the harnesses were set in motion electromagnetically. The subject of my research works was the nature of motion damping of harnesses which were suspended elastically and realizing oscillatory movement. The issue of crossing resistance of warp sheets (technological damping) was the subject of a paper I delivered at a conference Arch-tex Innovation in Textile Technology, in 2001 in Lodz. Research works on resonance creation of shed in the context of technological resistance have resulted in publications [2.1, 2.5] and the defence of doctoral thesis entitled ***Using resonance in shed forming mechanism for improving its kinetics*** in 2002.

I used the experience gained during the research works to formulate patent application No. P390315 entitled Harness together with doc. Z. Wroclawski and prof. J. Słodowy. The patent [6.1] granted by the Patent Office in 2013 relates to a flexible suspension of the harness on flat springs without using guides. The modified shape of the springs favors high resonance frequency of the system. Conclusions from the analysis of such a suspension made of different materials and in relation to their natural frequency were presented in [2.6].

The most important of my achievements from the period before obtaining doctor's degree in technical sciences, was – apart from the preparation and defence of doctoral thesis – gaining experience in conducting analytical and experimental studies in the field of construction and dynamics of resonance systems, as well as gaining practical engineering experience in machine design and construction.

1.2. Scientific, research and project activities after PhD

List of publications constituting the scientific achievement „Mechanism for vibration thickening of fabrics"

1. Kuchar M. 2013. *The vibration beat-up in the weaving loom*. Scientific Bulletin of Lodz University of Technology No. 1149 (ISSN 0137-4834 25 p. Ministry of Science and Higher Education)

Scientific publications in journals from database Journal Citation Reports (JCR)

2 Kuchar M. 2013. *Vibratory Thickening of Weft Threads in a Weaving Loom – Simulation Tests.* FIBRES & TEXTILES in Eastern Europe; 21, 5(101): 59-64. **(**ISSN 1230-3666 IF-0,541, 30 p. list A of Ministry of Science and Higher Education)

3 Kuchar M. 2015. *Comparative study on the conditions of thickening woven fabrics with a vibrating Reed.* TEKSTİL ve KONFEKSİYON 25(2): 155-159 **(**ISSN 1300-3356 IF-0,287, 20 p. list A of Ministry of Science and Higher Education)

4 Kuchar M., Siczek K. 2016. *Simulation of a vibrating reed exciter for thickening fabrics in the weaving loom*. MECHANIKA. Vol 22(5): 410-415 (ISSN 2029-6983 IF-0,277, 15 p. list A of Ministry of Science and Higher Education)
My contribution consisted of: modeling vibration mechanism of the reed, performing numerical simulations of reed movements, compiling simulation results. It can be estimated as 60%.

5 Kuchar M. 2016. *The impact of the frequency of reed vibrations on improving the conditions in thickening dense technical fabrics* TEKSTİL ve KONFEKSİYON 26(4): 380-384 (ISSN 1300-3356 IF-0,287, 15 p. list A of Ministry of Science and Higher Education)

Scientific publications in journals other than listed in JCR database

6 Kuchar M., Słodowy J. 2006. *Electromagnetic device for vibration thickening of wefts during weaving*, (in polish) Maintenance Problems, 1/2006, 71-82, (ISSN 1232-9312, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: literature analysis of possible drives of the vibratory motion of the reed, developing the concept and execution of electromagnetic drive, developing the concept of a flexible weaving reed, conducting bench testing, compiling measurement results. It can be estimated as 70%.

7 Kuchar M., Siczek K. 2006. *Theoretical and experimental research on the behavoiour of flexible reed in a vibration beat-up mechanism*, (in polish) Maintenance Problems, 2006/3, 143-155, (ISSN 1232-9312, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of:: developing the concept of a flexible undercut weaving reed, developing assumptions for numerical model, material analysis, determining initial and boundary conditions, compiling measurement results. It can be estimated as 50%.

8 Kossowski Z., Kuchar M., Siczek K. 2007. *The theoretical analysis of conditions of action of magneto-electrical actuator,* Electrotechnical Review, 7-8/2007, 20-25 (ISSN 0033-2097, 6 p. list A of Ministry of Science and Higher Education)
My contribution consisted of: developing the concept and construction of the test stand, conducting bench testing, comparative analysis of the results. It can be estimated as 33.3%.

9 Kossowski Z., Kuchar M., Siczek K. 2010. *The Analysis of Energy during Vibratory Thread Compaction,* Textiles Review: Textiles, Garments, Leather, 12/2010, 28-32 (ISSN 1731-8645, 6 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: conducting bench testing, developing dynamic model and necessary assumptions, comparing measurement results with the numerical ones. It can be estimated as 33.3%.

10 Kuchar M., Słodowy J. 2011. *Operational and technological aspects of vibratory thread compaction,* Textiles Review: Textiles, Garments, Leather, 4/2011, 26-28 and 5/2011, 23-25 (ISSN 1731-8645, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: conducting bench testing, compilation and analysis of measurement results. It can be estimated as 70%.

11 Kuchar M., Michalak A. 2012. *Cling of threads as a parameter accompanying the acting force during weaving.* Textiles Review: Textiles, Garments, Leather, 7/2012, 19-22 (ISSN 1731-8645, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: developing the concept and construction of the test stand, conducting bench testing, compiling measurement results. It can be estimated as 50%.

Scientific achievement entitled *The vibration beat-up in the weaving loom*

After obtaining doctor's degree in technical science, in the years 2002-11, I continued research works in the field of dynamics and resonance structures of the mechanisms of weaving machines. Together with prof. J. Słodowy, I dealt with the issues of improving the conditions of thickening fabrics in the loom. Weaving reed, which in addition to its principal motion, resulting from the movement of the slay in the weaving cycle, is additionally set in vibratory motion, realizes the process of vibration thickening of wefts. Additional vibratory motion of the reed is characterized by significantly smaller amplitude and higher frequency comparing to its principal motion. A description of the construction of the vibrating beat-up mechanism and some results of preliminary research are presented in [6]. Vibratory motion of the reed during fabrics thickening has a positive effect on reducing dynamic loads, mainly of the reed and the warp and on the obtained weft density in the produced fabric. Within the project No. 4T07C02628 financed by the Committee for Scientific Research entitled ***Theoretical and experimental research on vibration beat-up mechanism in a weaving loom*** [5.1] in which I performed duties of the manager, I carried out a multiparameter analysis of the process of vibration thickening of fabrics. I designed, developed and executed a vibration beat-up mechanism which became an equipment of a weaving loom. The concept of the mechanism was based on a flexible, undercut weaving reed, set in vibratory motion by a magnetoelectric exciter. With this construction I obtained the amplitude of the vibratory motion of the reed at the height of the fabric fell of 0,3-0,6mm at a frequency of 350-450Hz. At insertion frequency of the loom of about 3 Hz it allowed me to obtain several strokes of the reed on the fabric fell in one thickening cycle. On the testing loom I produced fabric samples of high density (with high degree of thickening) which resulted in a relatively long thickening time, up to 20% of the working cycle of the loom. Certain aspects of the conducted dynamic analyses of the construction and conclusions arising therefrom are presented in [7-9]. As a result of equipping the loom with the new beat-up mechanism a stand was established for vibration thickening of fabrics [3.1]. The experience gained during constructing the stand was presented at the XXIII PKM symposium Rzeszow - Przemysl in 2007 in which I took an active part [4.3, 4.4].

Research on the process of vibration thickening of fabrics moved in two ways: bench testing and simulation studies.

Within bench testing I made some measurements of dynamic parameters during thickening the fabrics with a rigid and a vibrating reed. I compared the force loading the reed (ie. the so-called beat-up force), dynamic load of the warp and density obtained in the fabric samples produced during the

tests. I identified and described characteristic parameters of the cross-sections of weft threads in the produced fabric samples. The collected research material allowed me to formulate some basic conclusions. As a result of using a vibrating reed during thickening of fabrics I obtained a reduction of the slay and warp load in the range of 10-20%. Wherein improvement of the thickening conditions occurs: with enlarging thickening zone, that is the reed displacement during its contact with the fabric fell and with reducing pretension of the warp. I also obtained increased density in the produced fabric samples in the range of 3-7%. The increased density is accompanied by reduction in the areas and changes in the shapes of the weft cross-sections. Detailed results of the analyzes and conclusions from bench testing are presented in [3, 10, 7.1].

Using my own research experience and the collected research material I developed a dynamic model of the mechanism for vibration thickening of fabrics. In this model, the fabric thickening zone consists of two zones of dynamic impact- fabric formation zone and the flexible zone of the fabric-warp system. The reed displacement is therefore a sum of displacements: of the weft on the warp thread with resistance of weft insertion into the fabric and of the fabric fell in the flexible system of warp and fabric. Using the model and programming in the CAD environment, I developed a program simulating the working of the mechanism for vibration thickening of fabrics.

As part of the simulation tests I conducted a multiparameter analysis of the impact of the vibratory motion of the reed on improving the conditions of fabric thickening. The obtained results were partly verified with the results of bench testing. In particular, I determined the impact of the frequency of the vibratory motion of the reed on improve thickening conditions. This effect is difficult to explore on the test stand due to the resonant nature of the vibratory mechanism. However, the results of the conducted simulations allowed to draw some conclusions. Generally, any increase in the amplitude and frequency of the vibratory movements of the reed improves the thickening conditions. The impact of frequency is much greater than of the amplitude. In the assumed range of parameters of the exciting forces I obtained a reduction in the dynamic load of the reed and the warp of up to 30%. Assessing the process of vibration thickening of fabrics from energy viewpoint I did not observe any benefits. Simulation analysis shows that total energy of thickening with vibrating reed (of the slay and the exciter) is greater than the beat-up energy with a rigid reed. Detailed results and conclusions from simulation studies are presented in [2, 3, 9].

The monograph entitled ***The vibration beat-up in the weaving loom*****,** published in 2013 in Scientific Bulletin of Lodz University of Technology [1] was a summary of my research work in the field of operation of the vibration beat-up mechanism.

The aim of the monograph was to identify tribological and dynamic phenomena during vibration thickening of fabrics, which refer to both- the beat-up mechanism and the processed fabric. This objective was achieved during bench testing by observing the changes in the dynamic and geometric parameters during thickening and the obtained results. Based on the results of bench testing I developed dynamic models and then simulation programs combining the dynamics of the slay equipped with a vibrating reed with motion resistance associated with fabric thickening. Gaining the ability to simulate the mechanism of vibration fabric thickening made it possible to realize the main aim of the monograph, which was determination of the conditions for effective vibration thickening of fabrics, resulting in tangible technical and technological benefits. In the monograph I made the following assumption: thickening the wefts with vibrating reed, which apart from its primary movements also undergoes an additional vibratory motion, of significantly smaller amplitude and higher frequency, makes it possible to:

- reduce the resistance forces in weaving – i.e. forces loading the reed during thickening. It reduces the devastating impact of the reed on the textile material, especially on the warp and reduces dynamic loading of the beat-up mechanism, unloading the construction of the machine and improving its usage conditions

-widen the possibilities of obtaining dense structures of the produced fabrics.

Most important issues described in the monograph, and constituting my individual academic achievements, partly presented in publications and studies include:

- Prototype of vibration beat-up mechanism for fabric thickening, constructed on the basis of experience and analyzes conducted before and during bench testing,

- Determination of reed and warp load during fabrics thickening and fabric density obtained with rigid and vibrating reed by real values of weaving parameters (pretension of the warp, size of the thickening zone)

- Identification of the dynamic model and development of programs simulating the mechanism of vibration thickening of fabrics,

- Verification of some of the results of simulation studies with the results of bench testing,

- Verification of the monograph thesis by comparing reed and warp load during fabric thickening and density obtained with rigid and vibrating reed

- Determination of energy components during fabric thickening with rigid and vibrating reed,

- Analysis of warp load during thickening the wefts with rigid and vibrating reed.

The effects of using a vibrating reed during fabric thickening described in the monograph, in the form of a 10-20% reduction in dynamic load of the reed and the warp and 5-7% increase in density, indicate the possibility of using a vibration beat-up mechanism for fabric thickening on an industrial scale. The acquired research experience indicates that the described mechanism may be applied in rapier looms for heavy fabrics.

In addition to tribological issues – concerning resistance of fabric thickening, in 2012 together with MSc. A. Michalak I managed to determine experimentally and describe the nature of changes of the so-called clinging forces between the threads. Under certain conditions, these forces constitute a measurable component of fabric thickening resistance. The value of clinging force is subject to slight changes. The peak value of the force depends on dynamic conditions. More detailed data are presented in [11].

In 2014, together with Dr. K. Siczek I analyzed the working conditions of the exciter of vibratory motion of the reed in the mechanism for fabric thickening. To the best of my knowledge, mechanisms of such a construction, described in literature as magnetoelectric exciters are not produced on an industrial scale. Based on MES environment I determined the inductance value of the exciter. I obtained a relatively constant level of inductance in the expected range of its displacements within the vibration mechanism. I created a dynamic model of the vibrating reed and electrical model of the exciter operation. From the research material obtained on the test stand, I determined the values of dynamic parameter, in particular damping of the vibratory motion of the reed- in relaxed phase and in the phase when the reed contacts the fabric fell, that is in the thickening phase [1, 6]. Using the theory of electrodynamic analogy, I enriched the previously developed CAD software for simulating the mechanism for vibration thickening of fabrics with an electrical module, simulating the operation of the exciter of reed vibrations. After dynamic simulations of the vibration system I determined the amplitudes of the vibratory motion of the reed in both phases. Significant increase in damping and relatively low in stiffness in the thickening phase reduces the amplitude of the vibratory motion of the reed. I accepted the minimum amplitude at the level of 80-90% of the amplitude from before the reed contact with the fabric fell. I established that in order to maintain the minimum amplitude, the rigidity of the vibrating reed in relation to the stiffness of the fabric-warp system should be greater than 30. Detailed data concerning simulation results are presented in [4].

In 2015., based on the ability of simulating the operation of the mechanism for vibration thickening of fabrics equipped with the exciter I once again repeated the research on the effects of the frequency of vibratory motion of the reed on the conditions of fabric thickening. This time the simulation focused on thickening heavy technical textiles. Generally, an increase in the frequency of vibratory motion of the reed improves the thickening conditions. However, at the same level of periodically constant power supply to the exciter, the frequency increase reduces the amplitude of the vibratory motion of the reed. Thus, I made an assumption that the influence of this parameter on the thickening effect is ambiguous. Having analyzed the simulations results I formulated some conclusions. The effect of vibration thickening in case of heavy fabrics is quite significant. A reduction was observed of the dynamic loads of the warp, particularly at high frequencies, of up to 60%. It was

confirmed thereby that the increase in the frequency of vibratory motion of the reed improves the conditions of fabric thickening, including heavy fabrics. However, there is a boundary frequency above which thickening conditions do not further improve. In case of the conducted simulations this frequency was in the range of 600-800Hz. Detailed data and obtained results are presented in [5].

In 2016. In collaboration with prof. A. Stefański and Dr. K. Siczek I attempted to mathematically describe the tribological phenomena occurring at the friction centers between threads during weft thickening. Analysis of friction phenomena between the warp and weft was the subject of the article presented at a scientific conference Nordtrib 2016, 17th Nordic Symposium on Tribology - June 14-17, 2016 - Hämeenlinna, Finland [4.8]

The other scientific activity

Continuing research on issues concerning beat-up mechanisms working on the basis of resonance phenomena, together with prof. J. Słodowy I focused on the concept of accumulation slay. Conventional slay can be converted into an accumulation one by replacing its rigid brackets with the ones characterized by elastic susceptibility in the plane of slay swinging, and coupling with it an excitation generator with a frequency equal or close to the resonant frequency of the resulting system. The excitation may be derived from the crank (eccentric), but an interesting solution is electromagnetic excitation at which a vibrating self-excited system is formed with stable conditions. The discrepancy between the state of maximum kinetic energy of a rigid slay, and the state of weft thickening at its minimum kinetic energy demonstrates that this issue is not properly solved in the currently used beat-up mechanisms. In its new resonance form an energy accumulator was used, which having collected energy in the potential form, releases it in the right place and time.

Such an accumulator is a flexible wishbone and so the system of kinematic excitation of slay movements transforms into an oscillator operating at resonant frequency, and the beat-up mechanism takes an oscillating-accumulating form. The oscillator working with resonant frequency draws minimum energy for its work - only as much as the energy of weft thickening. Both slays – the rigid and the accumulating - differently affect the beat-up force. Kinematic weft pressing by rigid slay lasts longer, but it is weaker than the dynamic stroke of a flexible slay. This is important for different assortments of threads and fabrics processed on the loom. Analytical and experimental pre-recognition on a physical model showed that resonant accumulating slay has some advantages over the previously used one. The accumulating slay applied in the weaving looms has the following characteristics:

- More efficient weft thickening, resulting in energy gain,
- Thickening the wefts with more energy, resulting in the possibility of producing fabrics of greater density. I presented a concept of an accumulating slay based on a torsion beam and magnetoelectric excitation. The new concept of the slay was a subject of three project applications. Despite positive reviews (e.g. Project NN 502 265 737, final evaluation of reviewers 9,5p. and 7,5p.) Ministry of Science and Higher Education in 2008-2009 did not qualify the project for funding.

In years 2008-10, together with Dr. K. Siczek I dealt with the problems of motion resistance and camshaft wear in internal combustion engine, as part of a research project of the Ministry of Science and Higher Education NN 502394535, entitled ***Tribological problems concerning camless actuation of valves of timing piston in an internal combustion engine*** in which I was a contractor [5.2]. The project included identification of tribological processes and phenomena in handle-guide and valve head- seat assemblies for valves made of steel and titanium alloys, with cam- and camless actuation. The recognition was made by analytical and experimental analysis of the phenomena of wear and mixed friction between the valve handle and its guide occurring by changing participation of smooth friction. Within the project I was involved in developing research methodology of bench testing. I was a co-author of the construction of two research stands:

- for simultaneous testing of motion resistance between the handle and the guide, the impact force of the valve on the seat and noise level for magnetoelectrically driven valves, at different frequencies and valve stroke for different seat and guide temperature,
- for simultaneous testing of valve, seat and guide wear and noise levels for different rotational speeds of the camshaft, valve stroke and seat temperatures, with the possibility of simulating the effect of gas force using an additional set of springs.

I was involved in bench testing, which included: determining the guide load with motion resistance and transverse reactions from the handle of the valve, valve and valve seat wear and noise emitted by the working valve. These parameters were determined in variable temperatures for classic, cam and magnetoelectric actuation of the valve. Research on MAN tribotester in which I participated, included determining motion resistance, wear, temperature and noise levels for different pairs of friction materials used for valves, guides and valve seats. The results and conclusions from the study are presented in [2.9, 2.10].

Based on research experience and programming environment CAD, I developed a simulation model of friction and a program for simulating the movements of the valve of an internal combustion engine, for dynamic conditions of intake and exhaust valve. The program includes dynamic analysis of the movement of engine valve with cam- and camless (magnetoelectric) actuation. Using the program, I analyzed the influence of the valve actuation system on motion resistance and velocity of settling in the seat. I analyzed the impact of the algorithm of magnetoelectric control of the valve on its velocity of settling in the seat. I focused on the possibility of engine control by opening the valves, in a 4 and 2-stroke cycle alternately. The results and conclusions from simulation studies are presented in publications [2.7, 2.8, 2.16]. I was also a co-author of the article presented at a scientific conference Nordtrib 2014 16-th Nordic Symposium on Tribology, 10-13 June 2014 Aarhus, Denmark [4.6]

In 2009-2011, in cooperation with Lodz department of the Institute for Sustainable Technologies in Radom, I dealt with the implementation of a research project of the Ministry of Science and Higher Education NN 507317236 entitled ***Method for creating*** **weaveless** ***textile structures*** [5.3]. Within the project, together with prof. M. Wisniewski and prof. J. Słodowy I participated in the works on a new system of producing flat weaveless textile products in the form of building grids. The manufacturing process without the shed assumed constant movement of the generating elements of the manufacturing device. I am the author of the prototype of a machine which can realize such a process. Manufacturing a textile product without weaves was possible thanks to wrapping weft thread (PCV covered glass roving) around locally shifted pegs situated on the circumference of the drum. From the creel frame the drum takes out warp threads (which are the same as the weft thread) which press the weft to the surface of the drum. The flat product was thermally consolidated. In order to facilitate the process of wrapping weft roving, it was planned to stick out a single peg on one side of the drum, and two pegs simultaneously on the other side by means of two rotating ball follower. The pushers initiate sticking out the pegs and they are actuated by the drum- by meshing the balls with the holes in the sticking out pegs. I am a co-author of the invention of a rotating ball follower for which patent was granted by Polish Patent Office in 2014 (no. P.394865) [6.2]. The characteristics of the follower and guidelines for its construction were presented in [2.2]. As a mechanism carrying the weft a roller chain transmission was used with constant circumferential velocity and a thread guide attached to the stretching bar. The new method of manufacturing weaveless textile structures in the form of building grids is more specifically discussed in [2.12].

Based on the experience gained during the analysis of damping oscillatory motions of machines elements, an idea was born of recovering energy of motor car body vibrations. Starting from 2010 I have been conducting scientific work, together with Dr. K. Siczek, on a new concepts of automotive shock absorbers. I analyzed the possibility of recovering air pressure energy in a pneumatic shock absorber. I developed the construction of a shock absorber with energy recovery with equipped with a turbogenerator. Based on CAD programming environment, I developed a program for dynamic simulating of the action of such an absorber. Based on the program, I conducted an analysis of the

damping properties of the new shock absorber and its capacity for energy recovery. I determined the impact of different traffic conditions and tires parameters on the amount of recovered energy. The results and conclusions from the conducted simulations are presented in publications [2.11, 2.13, 2.14, 2.15, 2.17]. Problems of automotive shock absorber recovering energy of motor car body vibration was the subject of a project application to the National Science Centre in Krakow. The project was not approved for funding.

Based on the experience connected with the dynamics of textile machine parts, in 2014 I started working on the elements of a warp-knitting machine for spatial knitted fabrics (ie. 3D knitted fabrics). Together with prof. Z. Mikołajczyk I made an attempt to model dynamics of the knitting zone. The basis for the modeling was the construction of a warp-knitting machine with four needle bars, developed by MSc. A. Michalak. I developed a dynamic model of slide mechanism, taking into account the influence of warp threads. The process of creating spatial knitted fabrics is characterized by intense feeding with warp threads, and thus a significantly greater dynamic load of the warp comparing to warp load during manufacturing classic knitted fabrics. As a result of the applied solutions I obtained changes of dynamic parameters, mostly of the slide mechanism. I performed multivariate simulations to determine the required parameters of the drive and dynamic load of the warp for creating spatial knitted fabrics. The obtained results and conclusions are presented in [2.3]. I was also a co-author of an article concerning the dynamics of actuation in a warp-knitting machine with four needle bars presented at the 47th International Federation of Knitting Technologists Congress - September 25-26, 2014 Izmir Turkey [4.7].

After simulation studies on the warp-knitting machine for spatial fabrics I focused on analyzing the dynamics of pneumatically driven slide mechanism. According to the results of previously conducted simulations such a drive fulfilled the basic criteria connecting force, speed and range of displacements. I completed the dynamic model with load corresponding to a specific pneumatic actuator and performed simulations of the movement of the slide mechanism. Simulation results helped to identify some limitations in the operation of the mechanism. The obtained durations of slide travel showed difficulties in achieving productivity of the warp-knitting machine of above 5 cycles per second. Dynamic loading of warp thread made of aramid fibers was identified at safe level, without causing breakages. The ranges of optimum values of knitting parameters were determined. Detailed results and conclusions are presented in [2.4].

I am aware that the results I obtained situate my research at the beginning of the road. My future scientific plans relate to the continuation of experimental and simulation studies on the mechanisms of oscillatory motion, based on resonance phenomenon for various applications. My plans concerning textile machinery focus primarily on the mechanism of oscillatory motion of a weaving loom and a warp-knitting machine with four needle bars. I take into account gradual replacing of classic crank devices with resonant mechanisms based on electromagnetic actuation. I am also interested in the issue of energy recovery, which is irretrievably lost in the mechanism of oscillatory motion in automotive vehicles.

2. DIDACTIC ACTIVITIES

I have been conducting educational activities since I was employed at the Faculty of Mechanical Engineering of Lodz University of Technology, i.e. since 1993. (with a pause in 1996-98). Initially, as an assistant and senior assistant at the Institute of Machine Design, I conducted tutorials and laboratory classes in *Descriptive Geometry* for the students of the Faculty of Mechanical Engineering and project classes in *Technical Drawing* for the students of the Faculties of Mechanical Engineering, Electrical Engineering and Environmental Engineering. For some time I also conducted tutorials, seminars and projects in *Basics of Machine Design* for the Faculty of Electrical Engineering and the Faculty of Organization and Management.

After promotion to the position of assistant professor, in 2004 I held lectures, tutorials, laboratories and projects in *Descriptive Geometry* for the students of the Faculty of Mechanical Engineering, specializing in Papermaking and Printing and project classes in *Technical Drawing* for the specialization Mechanical Engineering and Machine Design, for full-time and part-time students.

Since 2005, I have conducted lectures and seminars in *Descriptive Geometry*, which was a part of the teaching program of the subject *Structures Recording*, and later after the teaching programs were modified - the subject *Engineering Graphics*, at the Faculty of Mechanical Engineering, for full-time and part-time students of Power Engineering and Transport. The program of these subjects also included computer laboratory classes in CAD systems.

In the last five years I have conducted lectures, seminars and project classes in *Engineering Graphics* for the students of the Faculty of Mechanical Engineering, studying Power Engineering, Transport and Production Engineering, both full-time and part-time. I also hold lectures, laboratory and project classes in *Engineering Graphics* for the students of the Faculty of Electrical Engineering studying Transport and Power Engineering. The classes include making technical drawings of machine parts from nature as well as drawings in electronic form in CAD systems. In addition, I also conduct laboratory classes in the subject *Computer Aided Design* at the Faculty of Mechanical Engineering for the students of Mechatronics. The classes include spatial modeling in CAD systems. In the academic year 2009-10 I began conducting seminars, project and laboratory classes in *Basics of Machine Design* at the Faculty of Mechanical Engineering, for the students of Mechanical Engineering and Machine Design and Transport, in full-time and part-time first degree studies. The program of the subject *Basics of Machine Design* includes strength calculations of machine parts by conventional methods and with the use of computer simulations. Since the academic year 2013-14 I have been conducting laboratory classes in the subject *Constructing Machine Elements* at the Faculty of Mechanical Engineering for the students of Mechatronics and Mechanical Engineering and Machine Design. The course includes execution of the project of a machinery assembly in CAD (design and strength and operating calculations)

List of Completed Training Courses

- 3dmax – basic level, web connection – effect & animation. Lodz University of Technology, Institute of Electrical Machines and Transformers. Łódź 2002-02-08
- Modeling parts, assemblies, and preparation of technical documentation in Autodesk Inventor 2008. Lodz University of Technology, Faculty of Mechanical Engineering. Łódź 2008-01-17
- Advanced modules of Autodesk Inventor 2008. Lodz University of Technology, Faculty of Mechanical Engineering. Łódź 2008-06-11
- Spatial modelling using Inventor system, advanced level. Lodz University of Technology, Faculty of Mechanical Engineering. Łódź 2009-05-21
- ProEngineer training. Lodz University of Technology, Faculty of Mechanical Engineering. Łódź, 2011-12-16

- Catia programme. Lodz University of Technology, Faculty of Mechanical Engineering. Łódź, 2012

3. ORGANIZATIONAL ACTIVITIES

- I was several times appointed a supervisor of a student group at the Faculty of Mechanical Engineering TUL.
- I participated several times in the combined matriculation exams.
- I participated several times in the entrance exams to the Faculty of Civil Engineering, Architecture and Environmental Engineering
- In 2012, I was a member of the diploma examination commission for Transport study program in 2nd cycle studies at the Faculty of Mechanical Engineering.
- My duties comprise organizing and supervising cleaning and maintenance works in the drawing studio of prof. Witold Korewa at the Faculty of Mechanical Engineering TUL.
- In 2016 I became a member of the Faculty Board of Faculty of Mechanical Engineering, Lodz University of Technology as a representative of dependent employees

4. AWARDS AND HONOURS

- In 2011 I received an award of rector of Lodz University of Technology for achievements in educational activities.
- In 2014 I received an award of rector of Lodz University of Technology for achievements in educational activities.

2017.03.31 .....
date

Maciej Kuchar .....
signature

Maciej Kuchar
Lodz University of Technology
Faculty of Material Engineering
Department of Vehicles and Fundamentals of Machine Design

LIST OF PUBLISHED SCIENTIFIC WORKS OR CREATIVE OCCUPATIONAL ACHIEVEMENTS. INFORMATION ON EDUCATIONAL ACHIEVEMENTS, SCIENTIFIC COOPERATION AND ACTIVITIES POPULARIZING SCIENCE

(after Ph.D., according to regulation of the Minister of Science and Higher Education from 01.09.2011 on the criteria for assessing achievements of persons applying for post-doctoral degree)

1 List of publications constituting the scientific achievement „Mechanism for vibration thickening of fabrics"

1.1. Kuchar M. 2013. *The vibration beat-up in the weaving loom*. Scientific Bulletin of Lodz University of Technology No. 1149 (ISSN 0137-4834 25 p. Ministry of Science and Higher Education)

Scientific publications in journals from database Journal Citation Reports (JCR)

1.2 Kuchar M. 2013. *Vibratory Thickening of Weft Threads in a Weaving Loom – Simulation Tests.* FIBRES & TEXTILES in Eastern Europe; 21, 5(101): 59-64. **(**ISSN 1230-3666 IF-0,541, 30 p. list A of Ministry of Science and Higher Education)

1.3 Kuchar M. 2015. *Comparative study on the conditions of thickening woven fabrics with a vibrating Reed.* TEKSTİL ve KONFEKSİYON 25(2): 155-159 **(**ISSN 1300-3356 IF-0,287, 20 p. list A of Ministry of Science and Higher Education)

1.4 Kuchar M., Siczek K. 2016. *Simulation of a vibrating reed exciter for thickening fabrics in the weaving loom*. MECHANIKA. Vol 22(5): 410-415 (ISSN 2029-6983 IF-0,277, 15 p. list A of Ministry of Science and Higher Education)
My contribution consisted of: modeling vibration mechanism of the reed, performing numerical simulations of reed movements, compiling simulation results. It can be estimated as 60%.

1.5 Kuchar M. 2016. *The impact of the frequency of reed vibrations on improving the conditions in thickening dense technical fabrics* TEKSTİL ve KONFEKSİYON 26(4): 380-384 (ISSN 1300-3356 IF-0,287, 15 p. list A of Ministry of Science and Higher Education)

Scientific publications in journals other than listed in JCR database

1.6 Kuchar M., Słodowy J. 2006. *Electromagnetic device for vibration thickening of wefts during weaving*, (in polish) Maintenance Problems, 1/2006, 71-82, (ISSN 1232-9312, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: literature analysis of possible drives of the vibratory motion of the reed, developing the concept and execution of electromagnetic drive, developing the concept of a flexible weaving reed, conducting bench testing, compiling measurement results. It can be estimated as 70%.

1.7 Kuchar M., Siczek K. 2006. *Theoretical and experimental research on the behavoiour of flexible reed in a vibration beat-up mechanism*, (in polish) Maintenance Problems, 2006/3, 143-155, (ISSN 1232-9312, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of:: developing the concept of a flexible undercut weaving reed, developing assumptions for numerical model, material analysis, determining initial and boundary conditions, compiling measurement results. It can be estimated as 50%.

1.8 Kossowski Z., Kuchar M., Siczek K. 2007. *The theoretical analysis of conditions of action of magneto-electrical actuator,* Electrotechnical Review, 7-8/2007, 20-25 (ISSN 0033-2097, 6 p. list A of Ministry of Science and Higher Education)
My contribution consisted of: developing the concept and construction of the test stand, conducting bench testing, comparative analysis of the results. It can be estimated as 33.3%.

1.9 Kossowski Z., Kuchar M., Siczek K. 2010. *The Analysis of Energy during Vibratory Thread Compaction,* Textiles Review: Textiles, Garments, Leather, 12/2010, 28-32 (ISSN 1731-8645, 6 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: conducting bench testing, developing dynamic model and necessary assumptions, comparing measurement results with the numerical ones. It can be estimated as 33.3%.

1.10 Kuchar M., Słodowy J. 2011. *Operational and technological aspects of vibratory thread compaction,* Textiles Review: Textiles, Garments, Leather, 4/2011, 26-28 and 5/2011, 23-25 (ISSN 1731-8645, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: conducting bench testing, compilation and analysis of measurement results. It can be estimated as 70%.

1.11 Kuchar M., Michalak A. 2012. *Cling of threads as a parameter accompanying the acting force during weaving.* Textiles Review: Textiles, Garments, Leather, 7/2012, 19-22 (ISSN 1731-8645, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: developing the concept and construction of the test stand, conducting bench testing, compiling measurement results. It can be estimated as 50%.

2 List of other scientific works and achievements after Ph.D (not included in point I)

Scientific publications in journals from database Journal Citation Reports (JCR)

2.1 Kuchar M., Słodowy J. 2002. *Determination of the Crossing Resistance of Warp Threads in Shed Formation.* FIBRES & TEXTILES in Eastern Europe, April/June, 39-41, (ISSN 1230-3666 IF-0,667, 20 p. list A of Ministry of Science and Higher Education),
My contribution consisted of: developing a method for determining crossing of warp sheets, conducting bench testing, compiling research results. It can be estimated as 70%.

2.2 Kuchar M. 2014. *Terms of geometric action of rotating ball follower* MECHANIKA Vol 20(6): 577–581, (ISSN 2029-6983 IF-0,368, 15 p. list A of Ministry of Science and Higher Education)

2.3 Michalak A., Kuchar M., Mikołajczyk Z. 2015. *Simulation Tests of the Feeding System Dynamics on a Warp Knitting Machine with Four Needle Bars.* FIBRES & TEXTILES in Eastern Europe; Vol 23, 4(112): 127-133 **(**ISSN 1230-3666 IF-0,667, 20 p. list A of Ministry of Science and Higher Education).
My contribution consisted of: modeling the dynamics of the slide mechanism of the needle bars, performing numerical simulations, compiling the results. It can be estimated as 33.3%.

2.4 Michalak A., Kuchar M., Mikołajczyk Z. 2016. *Dynamic analysis of a warp-knitting machine with pneumatic drive for producing 3D knitted fabrics*. Article has been accepted for publication in 2017 in Indian Journal of Fibre and Textile Research (ISSN 0971-0426, IF-0,42, 25 p. list A of Ministry of Science and Higher Education)
My contribution consisted of: modeling the dynamics of the slide mechanism of the needle bars together with a drive, performing numerical simulations, compiling simulation results. It can be estimated as 33.3%.

Scientific publications in journals other than listed in JCR database

2.5. Kuchar M. 2003. Modelling of the crossing resistance of warp threads in shed formation, Tribology 4/2003, 265-277 (ISSN 0208-7774, 6 p. list B of Ministry of Science and Higher Education)

2.6. Kuchar M., Słodowy J. 2006. Analysis of a flexible suspension of a harness in a resonance mechanism (in polish), Maintenance Problems 1/2006, s. 83-92 (ISSN 1232-9312, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: developing an algorithm for calculating natural frequencies of the system, conducting material analysis, carrying out calculations and compiling the results. It can be estimated as 50%.

2.7. Siczek K., Kuchar M. 2009. *The evaluation of possibility for use of the magnetoelectric valve actuator in combustion engine of 2/4 stroke regime,* Combustion Engines 2009-SC2, 34-41 (ISSN 0138-0346, 6 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: Developing dynamic numerical model of an electromagnetically actuated valve, conducting analysis of working dynamics of valves of 2/4 stroke engines, compiling measurement results. It can be estimated as 50%.

2.8. Siczek K., Kuchar M. 2009. *The control of valve timing with magnetoelectric actuators,* Journal of KONES Powertrain and Transport, Vol. 16, No. 3 2009, 357-365 (ISSN 1231-4005, 6 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: Conducting dynamic simulations of a valve controlled by magnetoelectric actuator, compilation and analysis of calculation results. It can be estimated as 50%.

2.9. Siczek K., Kuchar M. 2010. *The Simulation Researches on the Wear for Elements of the Seat Insert-Valve-Valve Guide Assembly*, Journal of KONES Powertrain and Transport, Vol. 17, No. 4, 431-438 (ISSN 1231-4005, 9 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: developing a simulation model, conducting dynamic simulations of cam- and electromagnetically actuated valves and comparing simulation results. It can be estimated as 50%.

2.10. Siczek K., Kuchar M. 2010. *Research on the tribological parameters for materials couples used for valves, valve guides and seat inserts*, Tribology, 5/2010 (233), 253-262 (ISSN 0208-7774, 9 p. list B of Ministry of Science and Higher Education)
My contribution consisted of bench testing on MAN tribotester, conducting simulations of movement dynamics of the tribotester lever, compiling results of measurements and calculations. It can be estimated as 50%.

2.11. Kuchar M., Siczek K. 2011. *Evaluation for Energy Recovery from the Car Suspension with Use of Pneumatic Shock Absorber.* The Archive of Automotive Engineering 2/2011, 21-37. (ISSN 1234-754X, 5 p. list B of Ministry of Science and Higher Education)

My contribution consisted of: developing the concept of shock absorber with energy recovery, developing simulation model of the absorber, performing numerical calculations and results analysis. It can be estimated as 50%.

2.12. Kuchar M., Podsiedlik W., Słodowy J., Wiśniewski M. 2011. *The Method of Waveless Textile Structures Creation.* Maintenance Problems 4/2011, 195–204 (ISSN 1232-9312, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: developing the concept and construction of the test stand. It can be estimated as 30%.

2.13. Siczek K., Kuchar M. 2012. *The concept of new car shock absorber with energy recuperation.* The Archive of Automotive Engineering Vol. 56, No. 2, 2012, s.135-147 (ISSN 1234-754X, 5 p. list B of Ministry of Science and Higher Education)
My contribution consisted of*: participation in developing the concept of shock absorber with energy recovery, developing a simulation model of automotive suspension system, performing numerical simulations of the system response to violations on the road and results analysis.* It can be estimated as *50%..*

2.14 Kuchar M., Siczek K. 2012. *The analysis of dynamic for a car shock absorber with energy recuperation including tires parameters,* TTS Rail Transport Technology 2012, 649-658 (ISSN 1232-3829, 4 p. list B of Ministry of Science and Higher Education)
My contribution consisted of participation in developing the concept of shock absorber with energy recovery, developing a simulation model of the suspension system, performing numerical calculations and results analysis. It can be estimated as 50%.

2.15 Siczek K., Kuchar M. 2013. *Researches on the amount of recuperated energy by electromagnetic shock absorber in small car.* Journal of KONES Powertrain and Transport Vol 20 No.3 2013, 367-374 (ISSN 1231-4005, 6 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: modeling dynamics of the mechanism, conducting simulations, results analysis. It can be estimated as 50%.

2.16 Kuchar M., Siczek K. 2014. *Analysis of the mixed friction between the guide made of cast iron and the valve stem made of Ti6Al4V with and without protective layer*. The Archives of automotive engineering, Vol 64, No. 2, 37-47 (ISSN 1234-754X, 6 p. list B of Ministry of Science and Higher Education)
My contribution consisted of: Modeling the friction assembly, conducting simulations, results analysis. It can be estimated as 50%.

2.17 Kuchar M., Siczek K. 2014. *The ability of recuperation the energy accumulated in shock absorber during breaking.* The Archives of automotive engineering, Vol 65, No. 3, 29-35
My contribution consisted of: modeling dynamics of the absorber, conducting simulations, results analysis. It can be estimated as 50%.

3 Original project, constructional and technological achievements

3.1 Prototype of a vibration beat-up mechanism of a weaving loom 2006 Lodz University of Technology.
My contribution consisted of: developing the concept and construction of the mechanism, implementing the project, assembly, verification of the mechanism operation. It can be estimated as *90%.*

3.2 Test stand for simultaneous testing of friction between the valve handle and its guide, impact of the valve on the seat and noise level for magnetoelectrically driven valves, occurring in an internal combustion engine 2008. Lodz University of Technology.
My contribution consisted of: developing the concept of certain subassemblies, participation in construction implementation, verification of subassemblies operation. It can be estimated as *50%.*

3.3 Test stand for simultaneous testing of valve, seat and guide wear, noise level, valve stroke and seat temperature, with the possibility of simulating the effect of gas force using an additional set of springs. The valve was actuated by a camshaft. 2008. Politechnika Łódzka
My contribution consisted of: developing the concept of certain subassemblies, participation in construction implementation, verification of test stand operation. It can be estimated as 50%.

3.4 Prototype of a device for manufacturing weaveless textile products. 2010. Institute for Sustainable Technologies in Radom Lodz department
My contribution consisted of: developing the concept of certain subassemblies, participation in implementing the construction of the entire device, verification of subassemblies operation. It can be estimated as 50%.

3.5 Control mechanism of fire dampers and fire ventilation in ventilation systems. 2013. CIAT sp. z o.o. 95-050 Konstantynów Łódzki, Langiewicza 62
My contribution consisted of: developing the concept and preliminary project. It can be estimated as 60%.

4. Papers delivered at international and national scientific conferences

4.1 Kuchar M. 2003. *Modeling crossing resistance of warp sheets*, XXVI Tribological School Łódź-Niedzica 2003 – presenting author

4.2 Siczek K., Kuchar M. 2010. *Research on the tribological parameters for materials couples used for valves, valve guides and seat inserts,* XXXI Tribological School Łagów 2010

4.3. Kuchar M., Siczek K. 2007. *Construction of a vibration beat-up mechanism with a flexible reed*, XXIII Symposium Basis of Machine Design Rzeszów-Przemyśl, volume I, Conference proceedings p. 308-317 - presenting author

4.4. Siczek K., Kuchar M. 2007. *Theoretical analysis of a magnetoelectric exciter of vibratory motion of the reed in a vibration beat-up mechanism*, XXIII Symposium Basis of Machine Design Rzeszów-Przemyśl, volume I, Conference proceedings p.435-443 - presenting author

4.5. Siczek K., Kuchar M. 2009.*The analysis of dynamics for valves of camless valve train with electromagnetic actuators and nonlinear springs,* 10th Conference Dynamical systems theory and applications, December 7-10, Łódź, Poland, p. 361-368

4.6. Kuchar M., Siczek K. 2014. *Researches of the Friction between the Guide made of Phosphor Bronze and the Valve Stem made of Ti6Al4V with and without Protective Layer*. Nordtrib 2014, 16-th Nordic Symposium on Tribology, 10-13 June Aarhus, Denmark

4.7. Michalak A., Kuchar M., Mikołajczyk Z. 2014. *Constructive Assumptions of a New fourcomb warp-knitting machine.* 47-th International Federation of Knitting Technologists Congress September 25-26, Izmir Turkey

4.8. Kuchar M., Siczek K., Stefanski A. 2016. *Analysis of Friction in Contact between Bodies with Fractal Surface Geometry.* The 17th Nordic Symposium on Tribology – 14–17 June, Hämeenlinna, Finland

5. Participation and Managing of international and national research projects

5.1. Theoretical and experimental research on vibration beat–up mechanism in a weaving loom. 2005-2007. 4T07C 02628, 2005-2007 Lodz University of Technology, Lodz.
Kuchar M: Project manager

5.2. *Tribological problems concerning camless actuation of valves of timing piston in an internal combustion engine*. 2008-2010. NN 502 394535, Lodz University of Technology, Lodz.
Kuchar M: contractor

5.3. Method for creating weavless textile structures NN 507317236th 2009-2011. The project is financed by the Ministry of Science and Higher Education. Institute for Sustainable Technologies in Radom Lodz department, Lodz,
Kuchar M: contractor

6. Granted national and international patents

6.1. Wrocławski Z., Słodowy J., Kuchar M. 26-04-2013. *Harness.* Poland. Patent granted by the Polish Patent Office nr P.390315
Kuchar M: developing the concept of a flexible suspension of a harness, conducting bench testing verifying its correct operation, simulation tests on suspension geometry (20%)

6.2. Kuchar M., Podsiedlik W., Wiśniewski M. 25-09-2014. *Rotating ball follower.* Poland. Patent granted by Polish Patent Office No. P394865
Kuchar M: developing the concept of the follower, conducting simulations of the follower operation, determining ranges of geometrical parameters allowing proper operation of the follower, developing the construction, verifying its operation on a test stand (50%)

7. Collective works, research documentation, expert opinions

7.1 Kuchar M. 2007. *Report on the research project KBN 4T07C 02628,* Lodz University of Technology Łódź.

7.2 Szosland A., Kuchar M. 2011. *Court opinion concerning road accident for* Łódź-Śródmieście Criminal division VI, file reference number VI K 2147/10

7.3 Kuchar M., Michalak A. Pawelski Z. 2014. *Technical opinion concerning traditional engine LK 450 x6 – squirrel cage failure analysis and proposal of constructional changes* Łódź.

CITATIONS OF ALL THE ARTICLES
Web Of Science 3; without autocitations 0; h-index 1
Scopus 6; without autocitations 0; h-index 2
Google scholar: 48; h-index 4

Total impact factor according to Journal Citation Reports (JCR), in the year of publishing: 2,398 (2,818)*

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*IF values and points according to Ministry of Science and Higher Education include the publication [2.4] accepted for printing in 2017

Maciej Kuchar