**Biography (curriculum vitae)**



Dr Vladimir M. Kvrgić, Dipl. Ing. Mech, Full Research Professor

University of Belgrade, Institute Mihajlo Pupin, Robotics Centre

Volgina 15, 11060, Belgrade

Phone: +381 11 677 61 74

Mob: +381 63 349 288

vladimir.kvrgic@pupin.rs

[www.pupin.rs](http://www.pupin.rs)

#

# Dr. Vladimir Kvrgic has graduated in Mechanical Engineering from the University of Belgrade in 1981 with a special focus on control systems, robotics and machine tools. For his research on “Computing of the Sub-Optimal Grasping Forces for Manipulation of a Rough Object by Multifingered Robot Hand” he received his M.Sc. degree in Electrical Engineering from the University of Belgrade in 1991. For his thesis “The Development of an Intelligent System for the Control and Programming of Industrial Robots” he received his Ph.D. degree in Mechanical Engineering from the University of Belgrade in 1999.

# His present research activities are the development of a new algorithm for the robot forward dynamics needed for the robot simulation and algorithms for increasing the accuracy of the robots and the machine tools. His research interests are also control, programming and design of the robots and machine tools and multifingered robot hands.

# From 2017 he is working in the Robotics Centre of the Mihajlo Pupin Institute.

From 2007 till 2016 he was a General Manager of the Lola institute where he was also a Program Officer of the projects “A Control Algorithm for a Vertical 5-Axis Turning Centre“ and „Development of Devices for Pilot Training and Dynamic Simulation of modern Fighter Planes Flight: 3DoF Centrifuge and 4DoF Spatial Disorientation Trainer.“ Thereafter he was working as a senior scientific associate.

From 2000 till 2007 he was given the post of the General Manager of the IRL Machine Tool Factory where he was managing the development of the new Horizontal Milling and Boring machines, Vertical Turning Centres and a New 3-DoF Spatial Parallel Mechanism for Milling Machines with Long X Travel.

In 1994 he was given the post of the General Manager of the Lola Robotics Factory where he led the development and production of the Industrial Robots and automatic lines and machine for candy and pharmaceutical industry.

In 1981 he joined the ILR Machine Tool Factory in Belgrade to develop machine tools and industrial robots where he was a Designer and a Head of the Development Department. From 1991 till 1994 he was a Head of the Robotics Department of the Lola Institute, where he led the development of the Robot Controller.

 He is author of more than 100 scientific papers. Some of them are

1. **V. Kvrgic**, A. Ribic, Z. Dimic, S. Zivanović, Z. Dodevska, Equivalent Geometric Errors of Rotary Axes and Novel Algorithm for Geometric Errors Compensation in a Nonorthogonal Five-Axis Machine Tool, *CIRP Journal of Manufacturing Science and Technology*, 37 (2022) 477-488, <https://doi.org/10.1016/j.cirpj.2022.03.001>.
2. V. Kvrgic, J. Vidakovic, Efficient Method for Robot Forward Dynamics Computation, *Mechanism and Machine Theory* 145 (2020) (10368) 1-25, DOI: 10.1016/j.mechmachtheory.2019.103680.
3. J. Vidaković, **V. Kvrgić**, M. Lazarević, P. Stepanić, Computed Torque Control for a Spatial Disorientation Trainer, *Facta Universitatis Series: Mechanical Engineering* 18(2) (2020) 269–280, <https://doi.org/10.22190/FUME190919003V>.
4. J. Vidakovic, M. Lazarevic, **V. Kvrgic**, I. Vasovic Maksimovic, A. Rakic, Flight Simulation Training: Application, Classification, and Research, *International Journal of Aeronautical and Space Sciences*, (2021), <https://doi.org/10.1007/s42405-021-00358-y>.
5. J. Vidaković, **V. Kvrgić**, M. Lazarević, Control System Design for a Centrifuge Motion Simulator Based on a Dynamic Model, *Strojniški vestnik - Journal of Mechanical Engineering*, 64(7-8) (2018) 465-474.
6. Z. Dodevska, **V. Kvrgić**, M. Mihić, B. Delibašić, The Concept and Application of Simplified Robotic Models, *Serbian Journal of Electronical Engineering*, 16(3) (2019) 1-20.
7. **V. Kvrgic**,J. Vidakovic, M. Lutovac, G. Ferenc, V. Cvijanovic, A Control Algorithm for a Centrifuge Motion Simulator, *Robotics and Computer-Integrated Manufacturing*, 30 (2014) 399–412.
8. **V. Kvrgic**,Z. Visnjic, V. Cvijanovic, D. Divnic, S. Mitrovic, Dynamics and Control of a Spatial Disorientation Trainer, *Robotics and Computer-Integrated Manufacturing*, 35 (2015) 104–125.
9. **V. Kvrgic**, Z. Dimic, V. Cvijanovic, J. Vidakovic, N. Kablar, A Control Algorithm for Improving the Accuracy of Five-Axis Machine Tools, *International Journal of Production Research*, [52](http://www.tandfonline.com/loi/tprs20?open=52#vol_52)([10](http://www.tandfonline.com/toc/tprs20/52/10))(2014) 2983-2998.
10. D. Milutinovic, M. Glavonjic, **V.** **Kvrgic**, S. Zivanovic, A New 3-DOF Spatial Parallel Mechanism for Milling Machines with Long X Travel, CIRP Annals - Manufacturing Technology, 54-1, (2005) 345-348.
11. **V. Kvrgić**, Z. Dimic, V. Cvijanovic, D. Ilic, M. Bucan, A Control Algorithm for a Vertical 5-Axis Turning Centre, *International Journal of Advanced Manufacturing Technology*, 61(5-8) (2012) 569-584.
12. M. Glavonjic, D. Milutinovic, S. Zivanovic, Z. Dimic, **V.** **Kvrgic**, Desktop 3-Axis Parallel Kinematic Milling Machine, *The International Journal of Advanced Manufacturing Technology*, 46(1-4) (2010) 51-60.
13. Z. Dimic, D. Milutinovic, S. Zivanovic, **V. Kvrgic**, Virtual Environment in Control and Programming System for Reconfigurable Machine Robot, *Technical Gazette*, 23(6) (2016) 1821-1829.
14. N. Kablar, **V. Kvrgic**, D. Debeljković, Robust Stability of Singularly Impulsive Dynamical Systems: Mathematical Model and Stability, *Transactions of FAMENA*, 39(2) (2015) 23-32.
15. G. Ferenc, Z. Dimic, M. Lutovac, J. Vidakovic, **V.** **Kvrgic**, Open Architecture Platforms for the Control of Robotic Systems and a Proposed Reference Architecture Model, *Transactions of FAMENA*, 37(1) (2013) 89-100.
16. N. Kablar, **V. Kvrgic**, D. Debeljković, Singularly Impulsive Dynamical Systems with Time Delay: Mathematical Model and Stability, *Transactions of FAMENA*, 37(3) (2013) 65-74.
17. J. Vidaković, M. Lazarević, **V.** **Kvrgić**, Z. Dančuo, G. Ferenc, Advanced Quaternion Forward Kinematics Algorithm Including Overview of Different Methods for Robot Kinematics, *FME Transactions*, 42(3) (2014) 189-198.
18. Z. Dančuo, B. Rašuo, **V.** **Kvrgić**, V. Zeljković, Methodology of the Main Drive Selection for a Human Centrifuge, *FME Transactions* 40(2) (2012) 69-74.

# V. Kvrgić, Computing of the Sub-optimal Grasping Forces for Manipulation of a Rough Object by Multifingered Robot Hand, *Proc. IEEE Int. Conf. on Robotics and Automation*, Minneapolis (1996) **DOI:**[10.1109/ROBOT.1996.506973](https://doi.org/10.1109/ROBOT.1996.506973).

1. **V. Kvrgić**, M. Pavlović, Movement Statements and Interpolation Parameters of the Robot Language L-IRL, *Proc. 29th International Symposium on Robotics*, pp. 449-456, Birmingham (1998).
2. **V. Kvrgić**, M. Pavlović, D. Milutinović, Trajectory Planner of the Industrial Robot Controller, *Proc. 27th International Symposium on Industrial Robots*,  pp. 775-780, Milan (1996).
3. M. Pavlović, **V.** **Kvrgić**, Programming Automation Lines with Robots, *Proc. 27th International Symposium on Industrial Robots*, pp. 403-407, Milan (1996).
4. **V. Kvrgić**, M. Pavlović, D. Milutinović, A New Algorithm for the Inteiligent Robot Velocity Control, *Proc. Worid Congress on Inteiligent Manufacturing Processes and Systems*, Puerto Rico (1995).
5. **V. Kvrgić**, M. Pavlović, D. Milutinović, A New Algorithm for Inteiligent Smoothing of Robot Velocitv by Approximate PTP Motions, *Proc. 26th International Symposium on Industrial Robots*, pp. 345-350, Singapore (1995).
6. M. Pavlović, **V.** **Kvrgić**, Explicit Robot Language Support for Multiple Robot Programming, *Proc. ECPD International Conference on Advanced Robotics and Inteiligent Automation*, Athens (1995).
7. M. Pavlović, **V.** **Kvrgić**, Velašević D, L-IRL: High Level Programming Language for Robots, *Proc. European Robotics and Inteiligent Systems Conference*, Malaga, Spain (1994).
8. **V. Kvrgic**, J. Vidakovic, Kinematic Parameters for Generation of Acceleration Force Profile of a Centrifuge Flight Simulator, Proceedings of Papers – *5th International Conference on Electrical, Electronic and Computing Engineering, IcETRAN 2018*, Palić, Serbia, June 11 – 14, 2018, ISBN 978‐86‐7466‐752-1, pp. 1028-1033.
9. V. Majstorovic, S. Zivkovic, D. Djurdjanovic, R. Sabbagh, **V. Kvrgic**, N. Gligorijevic, Building of Internet of Things Model for Cyber-Physical Manufacturing Metrology Model (CPM3), 52nd CIRP Conference on Manufacturing Systems, Procedia CIRP 81 (2019) 862–867.
10. J. Vidaković, **V. Kvrgić**, M. Lazarević, Z. Dimić, Development of the algorithms for smoothing of trajectories of a roll and a pitch axis of a centrifuge motion simulator, *7th International Congress of Serbian Society of Mechanics*, Sremski Karlovci Serbia, 24-26st June, C1e, pp. 1-10, 2019.
11. **V. Kvrgić**, J. Vidaković, M. Lazarević, G. Pavlović, Calculation of the acceleration force components and roll and pitch link angles of the CFS and SDT, *6thInternational Congress of Serbian Society of Mechanics* Mountain Tara, Serbia (2017) C3a, pp. 1-10.
12. J. Vidaković, M. Lazarević, **V. Kvrgić**, M. Lutovac Banduka, Stefan M. Mitrović, Control system design of spatial disorientation trainer, *6thInternational Congress of Serbian Society of Mechanics* Mountain Tara, Serbia (2017) C2a, pp. 1-10.
13. S. Mitrović, Z. Dimić, J. Vidaković, M. Lutovac, **V. Kvrgić**, System for simulation and supervision of robotic cells, *MMA, Flexible technology, 12th International scientific confererence*, Novi Sad, Serbia (2015) pp. 51-54.
14. V. Cvijanović, **V.** **Kvrgić**, G. Ferenc, An Analysis of Contemporary Technologies for the Secure User to User Email Transfers, *DEMI International conference on accomplishments in Electrical and Mechanical Engineering and Information Technology* (2013) pp. 993-998, Banja Luka, Bosnia and Herzegovina, 30.5-1.6.
15. N. Kablar, **V. Kvrgic**, D. Debeljković, Robust control of singular systems with time delay. Part I: Continuous time case, [*Control Conference (ECC), 2013 European*](http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6657188) (2013) pp. 690 – 695, INSPEC Accession Number: 13936253, Conference Location: Zurich, Publisher: IEEE.
16. G. Ferenc, M. Lutovac, **V. Kvrgić**, P. Stepanić, A Proposed Approach to the Classification of Bearing Condition Using Wavelets and Random Forests, *Mediterranean Conference on Embedded Computing (MECO)*, *Proc*. ISBN 978-9940-9436-1-5, (2013), Budva, Montenegro, pp. 140-143.
17. M. Lutovac, **V. Kvrgić**,G. Ferenc, Z. Dimić, J. Vidaković, 3D Simulator for Human Centrifuge Motion Testing and Verification, *Mediterranean Conference on Embedded Computing (MECO)*, (2013), Budva, Montenegro, ISBN 978-9940-9436-1-5, pp. 160-163.
18. J. Vidaković, **V. Kvrgić**, G. Ferenc, Z. Dančuo, M. Lazarevic, Kinematic and dynamic model of the human centrifuge, *Proc. of the Serbian Society of Mechanics SSM Fourth Serbian Congress on Theoretical and Applied Mechanics,* pp. 627-632 (2013) ISBN 978-86-909973-5-0, COBISS.SR-ID 198308876.
19. M. Lutovac, J. Protić, **V. Kvrgić**,Remote Control of Industrial Robot Lola 50 using Wireless Communication and Android Device, *21st Telecommunications forum TELFOR* (2013), Belgrade, Serbia, ISBN: 978-1-4799-1419-7, pp. 885-888.
20. M. Lutovac, D. Bojić, **V. Kvrgić**,Automated Testing of L-IRL Robot Programming Language Parser, *21st Telecommunications forum TELFOR* (2013) Belgrade, Serbia, ISBN: 978-1-4799-1419-7, 825-828.
21. Z. Dančuo, B. Rašuo, V. Zeljković, J. Vidaković, **V. Kvrgić**,Accelerations in a high performance human centrifuge, *Proc. of the 29th Danubia-Adria-Symposium on**Advances in Experimental Mechanics*, (2012) Belgrade, Serbia, ISBN 978-86-7083-762-1, COBISS.SR-ID 193231372, pp.182-185.
22. J. Vidaković, **V. Kvrgić**,G. Ferenc, Z. Dančuo, M. Lazarević, Control of a human centrifuge, *Proc. of the 29th Danubia-Adria-Symposium on Advances in Experimental Mechanics* (2012) Belgrade, Serbia, ISBN 978-86-7083-762-1,COBISS.SR-ID 193231372, pp.186-189.
23. J. Vidaković, G. Ferenc, M. Lutovac, **V. Kvrgić**,Development and implementation of an algorithm for calculating angular velocity of main arm of human centrifuge,*15th International Power Electronics and Motion Control Conference and Exposition* (2012) ISBN 978-1-4673-1971-3, DS2a.17-1-6.
24. P. Stepanić, **V.** **Kvrgić**, N. Mišić, Z. Dančuo, I. Lazarević, Methods of Fault Detection in Rolling Element Bearings, *7th Balkantrib’11 International Conference on Tribology Proc.*, ISBN978-960-98780-6-7, Aristoteles University of Thessaloniki (2011) pp. 179-188.
25. M. Milićević, V. Kaplarević, Z. Dimić, **V.** **Kvrgić**, V. Cvijanović, Development of new control system for robots and multi-axis machining systems, *4th International Conference on Manufacturing Engineering ICMEN, Proc. EEΔM and PCCM*, ISBN 978-960-98780-4-3 (2011) pp. 451– 457.
26. V. Kaplarević, M. Milićević, J. Vidaković, **V.** **Kvrgić**, New Approach for Dessigning Robot Programing System Based on L-IRL Programing Language, *DEMI-10th Anniversary International Conference on accomplishments on in Electrical and Mechanical Engineering and Information Technology*, ISBN 978-99938-39-36-1 (2011) pp. 873-876.
27. **V. Kvrgić**, J. Vidaković, V. Kaplarević, M. Lazarević, Forward and Inverse Kinematics for vertical 5-axis turning center with angular head of non-intersectional axes, with compensatin for table moving caused by thermal dilatation, *The Third International Congress of Serbian Society of Mechanics*, ISBN 978-86-909973-3-6, 2011, pp. 138-142.
28. **V. Kvrgić**, M. Vasić, V. Čarapić, J. Vidaković, V. Komadinić, Research and development of the new generation five axis vertical turning centres, *34th International Conference on Production Engineering, Proc.*, ISBN 978-86-6055-019-6 (2011) pp. 129–132.
29. **V. Kvrgić**, Z. Dimić, S. Trgovčević, Razvoj 5-osnog vertikalnog strugarskog obradnog centra, *9. Međunarodna konferencija o dostignućima elektrotehnike, mašinstva i informatike (DEMI)*, Zbornik radova, ISBN 978-99938-39-23-1, Mašinski fakultet u Banjaluci (2009) pp. 249-254.
30. D. Milutinović, M. Glavonjić, S. Živanović, Z. Dimić, **V.** **Kvrgić**, Mini educational 3-axis parallel kinematic milling machine, *Proc. of the 3rd International Conference on Manufacturing Engineering (ICMEN)*, ISBN 978-960-243-649-3 (2008) Chalkidiki, Greece, pp. 463-474.
31. J. Jeftić, I. Latinović, **V.** **Kvrgić**, Investigation and development of a new original electrohidraulik metal forming technology*, Proc. of XLIII International Symposium on Electrical Machines SME* 2007, 2-5 July, Poznan, Poland, pp. 285-288.
32. **V. Kvrgić**, M. Vasić, V. Čarapić, D. Ilić, M. Bućan, Development of the next generation vertical turning centres, *4th International Conference on Manufacturing Engineering ICMEN, Proc.*, EEΔM and PCCM, ISBN 978-960-98780-4-3 (2011) pp. 153–163.
33. M. Lutovac, G. Ferenc, J. Vidaković, Z. Dimić, **V. Kvrgić**, Usage of HML and P code for Robot Motion Control“, *Mediterranean Conference on Embedded Computing MECO* (2012), Bar, Montenegro, ISBN 978-9940-9436-0-8, pp. 162-165.
34. G. Ferenc, Z. Dimić, M. Lutovac, J. Vidaković, **V. Kvrgić**, Distributed Robot Control System Implemented on the Client and Server PCs Based on the CORBA Protocol, *Mediterranean Conference on Embedded Computing MECO* (2012) Bar, Montenegro, ISBN 978-9940-9436-0-8, pp. 158-161.
35. Z. Dančuo, J. Vidaković, **V. Kvrgić**, Goran Ferenc, M. Lutovac, Modeling a Human Centrifuge as Three-DoF Robot Manipulator, *Mediterranean Conference on Embedded Computing MECO* (2012) Bar, Montenegro, ISBN 978-9940-9436-0-8, pp. 149-152.
36. Z. Dodevska, **V. Kvrgić**, M. Mihić, The Strategy of Building and Using Simplified Robotic Models in Engineering Projects, *6th International Conference on Electrical, Electronic and Computing Engineering, IcETRAN 2019*, Silver Lake, Serbia, June 03 – 06, 2019, pp. 1084.
37. J. Vidaković, A. Stepanović, M. Lazarević, **V. Kvrgić**, D. Divnić, Usage of CAE environment within control algorithms design for a centrifuge motion simulator, *The 10th International Symposium on Machine and Industrial Design in Mechanical Engineering-KOD 2018*, Novi Sad, Serbia, June 6-8, pp. 80-81 (2018).
38. J. Vidaković, **V. Kvrgić**, M. Lazarević, P. Stepanić, Computed torque control for a spatial disorientation trainer, *9th International Scientific conference Research and Development of Mechanical Elements and Systems - Irmes 2019*, Kragujevac, Serbia, September 5-7, pp. 172-173 (2019), ISBN: 978-86-6335-061-8.
39. **V. Kvrgić**, Dynamics and Control of a Centrifuge Flight Simulator and a Simulator for Spatial Disorientation, in: Advances in Robotics and Automatic Control: Reviews, Book Series, Vol. 1, S. Yurish (Eds.), Published by IFSA Publishing, S. L., <http://www.sensorsportal.com>, ISBN: 978-84-09-02449-0, BN-20180530-XX, BIC: TJFM1 S, 2018, pp. 93-154.
40. J. Vidaković, **V. Kvrgić**, M. Lazarević, Z. Dimić, S. Mitrović, *Procedure for Definition of End-effector Orientation in Planar Surfaces Robot Applications* -Tehnika –Mašinstvo, 72(6) 845-851, ISSN 0040-2176 (Savez inženjera i tehničara Srbije) (2017).
41. Z. Dodevska, **V. Kvrgić**, V. Štavljanin, Augmented Reality and Internet of Things, Implementation in Projects by Using Simplified Robotic Models, *European Project Management Journal*, 8(2) ISSN 2560-4961 (2018), DOI: 10.18485/epmj.2018.8.2.4.
42. M. Lutovac, Z. Dimić, S. Mitrović, A. Stepanović, **V. Kvrgić**, “Reconfigurable Virtual Environment for Multi-robot Operations and its Application in Education,” *Telfor Journal*, vol. 8, no. 2, 2016, pp. 127-132.
43. M. Lutovac, G. Ferenc, **V.** **Kvrgić**, J. Vidaković, Z. Dimić, "Robot programming system based on L-ILR programming language," *Acta Technika Corvinniensis* – (2012) Bulletin of Engineering, ISSN: 2067 - 3809 (online), [*http://acta.fih.upt.ro/pdf/2012-2/ACTA-2012-2-02.pdf*](http://acta.fih.upt.ro/pdf/2012-2/ACTA-2012-2-02.pdf), 2012, pp. 27-30.
44. G. Ferenc, Z. Dimić, M. Lutovac, **V.** **Kvrgić**, V. Cvijanović, "Distributed Robot Control System Based on the Real-Time Linux Platform", *Journal of Mechanics Engineering and Automation*, 2(3) (2012) ISSN 2159-5275 (Print), ISSN: 2159 - 5283 (online), pp. 184-189.
45. G. Ferenc, M. Lutovac, Z. Dimić, J. Vidaković, **V. Kvrgić**, Development of a real-time sytem based on the modular fsm in distributed system for robot control,*ANNALS of Faculty Engineering Hunedoara*, Tome XI (2013) Fascicule 2 ISBN 1584-2665, pp. 221-226.
46. Z. Dančuo, B. Rašuo, J. Vidaković, **V.** **Kvrgić**, M. Bućan, On Mechanics of a High-G Human Centrifuge, *PAMM, Proc. Appl. Math. Mech*. 13, 39–40 (2013) [Wiley-Blackwell](http://www.ingentaconnect.com/content/bp;jsessionid=9te91ta00q8nd.alice) / DOI 10.1002/pamm.201310015.
47. J. Vidaković, M. Lazarević. **V.** **Kvrgić**, Z. Dančuo, M. Lutovac, „Comparison of numerical simulation models for open loop flight simulations in a human centrifuge,“  [PAMM](http://www.ingentaconnect.com/content/bpl/pamm;jsessionid=9te91ta00q8nd.alice), vol. 13, no. 1 (2013) pp. 485-486(2), [Wiley-Blackwell](http://www.ingentaconnect.com/content/bp;jsessionid=9te91ta00q8nd.alice), **DOI:** <http://dx.doi.org/10.1002/pamm.201310235>.

**Engineering projects**

1. Double column vertical lathe DVS 40 CO, ILR Belgrade, 2006 - 2007.
2. Single column vertical lathe JVS 20 CO, ILR Belgrade, 2006-2007.
3. Single column vertical lathe JVS 24 CO, ILR Belgrade, 2006-2007.
4. Horizontal boring and milling machine – platen type, BG 130 CO, ILR Belgrade, 2005.
5. Three-axis vertical milling machine based on parallel kinematics mechanism - Lola robot factory - ILR Belgrade, 2005.
6. Single column vertical lathe JVS 16 CO, ILR Belgrade, 2004.
7. Horizontal boring and milling machine – table type, BH 110 CNC, ILR Belgrade, 2004.
8. Horizontal boring and milling machine – planer or T-bed type, HBG 130 CO, ILR Belgrade, 2003.
9. Single column vertical lathe JVS 18 CO, ILR Belgrade, 2003.
10. Robot controllers Lola RC 1, Lola RC 2, and Lola RC 3, Lola institute and Lola robot factory - ILR Belgrade, 1991 - 2000.
11. Machines for wrapping and packaging in pharmaceutical industry, Lola robot factory - ILR Belgrade, 1997.
12. Three-axis gantry robot, Lola robot factory - ILR Belgrade, 1995.
13. Two-axis robot with two four-bar mechanisms for manipulation in candy industry, Lola robot factory - ILR Belgrade, 1995.
14. Line for packaging with robots in candy industry, Lola robot factory - ILR Belgrade, 1995.
15. Algorithms and software for robot movements control - development, programming, tests and integration of the algorithms in industrial robot language L-IRL, Lola institute and Lola robot factory - ILR Belgrade, 1991 - 1997.
16. Industrial robot with six rotational axes - Lola 15, Lola robot factory - ILR Belgrade, 1991.
17. Manipulators for car industry and for special-purpose machine tools ILR Belgrade, 1981 - 1990.
18. Systems of transport and manipulation in transfer and flexible production lines, ILR Belgrade, 1981 - 1990.