

**APPLICATION ANALYSES OF INDUSTRIAL ROBOT
IN WORLD AUTOMOBILE INDUSTRY IN 2010**

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Abstract

Automobile industry occurs in an unenviable situation, due to a higher competition on automobile market and market contest for every customer. As a result, the existence of companies in automobile industry is not secured but presents a motif for the development. These days the market seeks from automobile industry better performances, better quality, higher security, less energy-generating products consumption and lower price. These are the consequences of the latest happenings on global market in automobile industry. The companies in automobile industry need to be innovative and automatize their manufacturing process, i.e. to modernise. The automation is impossible without industrial robot application in manufacturing process. This is the reason for the application analyses of industrial robots in automobile industry, and also owing to the highest number on the industrial robot world market has been applied in automobile industry. This paper provides cooperative analyses of the industrial robot application in automobile industry, at the annual level, regarding the other industrial branches in 2010. It provides the industrial robots application in this industry over the continents and countries with the most developed automobile industry, and also provides the rise and decline of the industrial robot application.

Key words: industry, automobile, industrial robot, robot application

1. INTRODUCTION

To satisfy the customer seeking from automobile industry better performances, better quality, higher security, less energy-generating products consumption and the lowest company price, their manufacturing process needs to be automatized and to apply the industrial robots in their manufacturing process [1, 2, 3, 4, 10]. Additionally, the new technologies need to be introduced. With the utilization of the new material, the new challenges of the key aspects of automobile designing are introduced considering the security, economics and ecology. Some of the examples are: the new material application, small particular weights with strengthen constructive solutions, a special design of the front bearer structure resistant to blasts, with the possibility of high blasts amortization, a broad electronic components application in order to improve security, economy and social environment protection. All these mentioned reasons are obtained through modernization and automation, i. e. investing in manufacturing process improvement of automobile industry and higher robotization of manufacturing process. The countries like: China, India, Thailand, Malaysia and Taiwan are making efforts to increase their involvement in automobile industry by increasing involvement in industrial robot application. In counties of Western Europe, North America and, which are traditional in automobile industry, reduced their involvement in industrial robot application. After the continuing slight fall of industrial robot application in automobile industry from 2005, in 2010 it becomes the biggest consumer of robot application. There has been applied 70% of robots more then in 2009. Considering the overall annual industrial robot application, automobile industry holds 35, 86 % in the World (2010).

2. STATISTICAL DATA OF THE WORLD INDUSTRIAL ROBOT APPLICATION

Statistical data of the industrial robot application are taken from (IFR)-International Federation of Robotics [4, 5, 6]. The data shown in Table 1 are providing the overall industrial robot application from 2005-2010 in Europe, America, Asia/Australia and Africa. The figure 1 presents industrial robot application trend in Europe, America and Asia from 2001 to 2010.

Table 1. Operational stock industrial robot application from 2005-2010 [1, 4, 5, 6]

<i>Application</i>	<i>Operational stock of industrial robots</i>					
<i>Country/Year</i>	2005	2006	2007	2008	2009	2010
<i>America</i>	143.634	154.680	165.328	173.977	172.141	179.785
<i>Asia/Austra.</i>	481.652	479.027	497.756	514.914	501.429	498.933
<i>Europe</i>	296.918	314.473	328.890	343.329	343.661	352.031
<i>Africa</i>	634	1.060	1.323	1.777	1.973	2.232
<i>TOTAL Σ</i>	922.838	949.823	999.264	1.035.301	1.020.731	1.035.016

According to the Table 1 it can be seen that in 2009, the total number of the industrial robot application was minimum due to the world industrial crisis. Observing the industrial robot application over the continent, first comes Asia/Australia with 498.933 units, then Europe with 352.031 robot units, America with 179.785 units and Africa with 2.232 units of the applied robots in 2010.

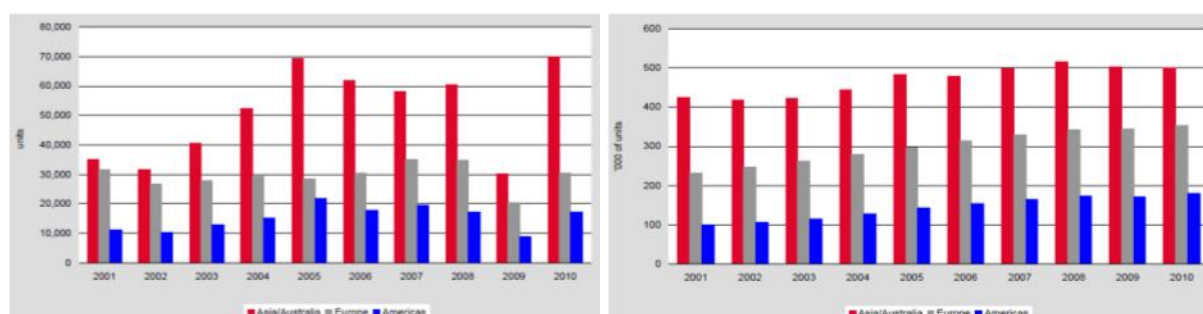


Figure 1. Annual supply and operational stock of industrial robots in Europe, America, Asia/Australia from 2001 to 2010 [5]

The Figure 1 presents the industrial robot application trend in the period of 2001-2010, at the annual level and total level in Europe, America and Asia. Here we come to the conclusion that at the annual level in 2009 and 2002 were years of minimum industrial robot applications. When we observe the world total industrial robot application over the continent, Europe and America are increasing the

robot application, while Asia for the past two years holds the constant trend of industrial robot application.

3. INDUSTRIAL ROBOT APPLICATION IN WORLD AUTOMOBILE INDUSTRY

According to the statistical data given in literature [1, 2, 6, 7,10], the Table 2, Table 3 and Figure 4 presents the annual and world industrial robot application in manufacturing process: plastic and chemical industry, metal industry, electro/electronic industry, automobile industry and the other industries(none of the mentioned groups), from 2005 to 2010.

Table 2. Annual supply of industrial robots by industrial branches

<i>Application</i>	<i>Annual supply of industrial robots</i>					
<i>Industr./Year</i>	2005	2006	2007	2008	2009	2010
<i>Chem., plastic</i>	11.494	15.728	15.703	12.575	6.852	10.518
<i>Metal product</i>	9.135	12.392	13.442	14.778	5.253	7.934
<i>Elec./electron.</i>	23.032	19.806	17.104	16.439	10.855	30.745
<i>Automotive</i>	48.936	40.467	40.920	40.437	19.260	32.702
<i>Other ind.</i>	8.403	9.264	10.243	10.035	2.042	9.277
<i>TOTAL Σ</i>	101.000	96.658	97.422	94.262	49.162	91.176

If we analyse the Table 2 we come to the conclusion that automobile industry is one of the leading industries in industrial robot application, than comes the electro/electronic industry and plastic and chemical industry. From 2005 to 2010, the annual robot application in automobile industry moves from 35% to 48%, considering the other industries. A sudden move of robot application in this industry was in 2010, in relation with 2009 (69, 79%) due to the industrial crisis in 2009.



Figure 2. Application of industrial robots in automobile body welding [10]

Table 3. Operational stock of industrial robots by industrial branches

<i>Application</i>	<i>Operational stock of industrial robots</i>					
<i>Industr./Year</i>	2005	2006	2007	2008	2009	2010
<i>Chem., plastic</i>	80.683	88.856	107.719	114.899	113.700	110.064
<i>Metal product</i>	71.446	81.313	90.361	98.515	98.245	97.427
<i>Elec./electron.</i>	123.310	134.240	141.429	147.755	144.457	146.539
<i>Automotive</i>	260.906	315.510	345.084	363.785	364.852	373.223
<i>Other ind.</i>	190.484	183.616	83.187	96.144	83.780	80.167
<i>TOTAL Σ</i>	626.829	703.745	767.780	810.098	806.034	807.410

When considering the total robot application in automobile industry, the Table 3 shows exactly the same figure as of the annual world industrial robot application. The first place takes the automobile industry, the second is electro/electronic industry and the third place takes the plastic and chemical industry.



Figure 3. Application of industrial robots in automotive industry assembly [3,10]

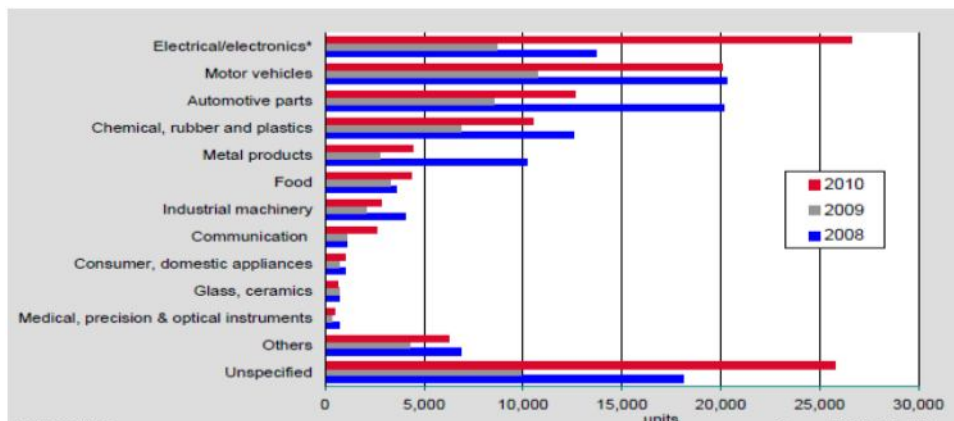


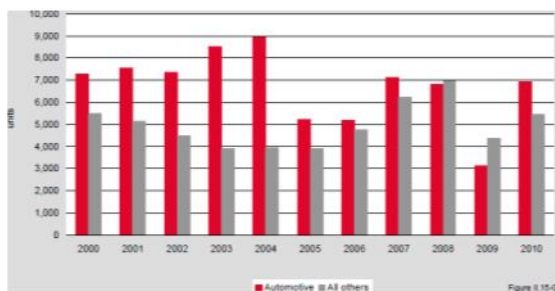
Figure 4. Annual supply of industrial robot application by industrial branches from 2008 to 2010 in the World

The graph on Figure 4 shows the annual industrial robot application in all industries and describes the deviation from each other in the past three years (2008, 2009, 2010).

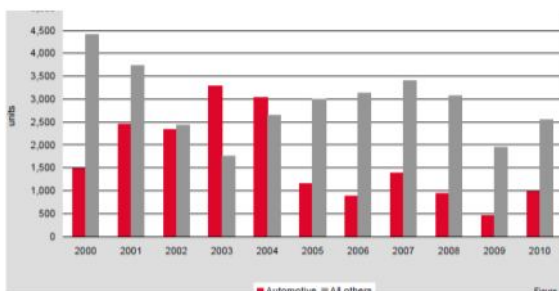
Table 4. Industrial robot application in 2010 by industrial branches [5]

<i>Application</i>	<i>Application of industrial robots by industrial branches and countries</i>						
<i>Country</i>	<i>Automo.</i>	<i>Elek/Ele.</i>	<i>Chem.</i>	<i>Metal.</i>	<i>Food</i>	<i>Other</i>	<i>Σ TO.</i>
<i>China</i>	8.300	1.800	1.452	1.800	300	1.326	14.978
<i>R.Korea</i>	7.056	12.644	727	253	84	2.744	23.508
<i>Germany</i>	6.929	700	1.343	1.705	913	2.410	14.000
<i>N.Amer.</i>	5.368	3.555	1.551	1.189	935	3.758	16.356
<i>Japan</i>	5.223	9.940	1.832	1.556	429	2.923	21.903
<i>Thailand</i>	1.500	28	491	2	4	427	2.450
<i>Italy</i>	978	141	697	802	478	1.424	4.517
<i>Spain</i>	941	64	100	119	304	369	1.897
<i>France</i>	848	128	241	154	282	296	2.049

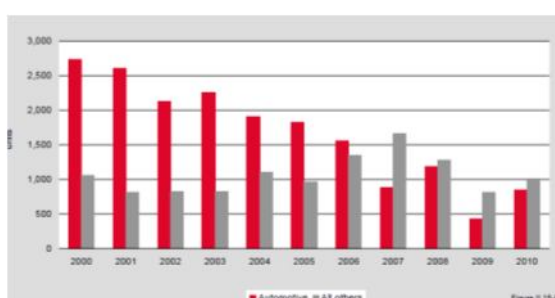
The next figures show the industrial robot application in four European countries with developed automobile industry: Germany, Italy, France and Spain [4,5,6,7].



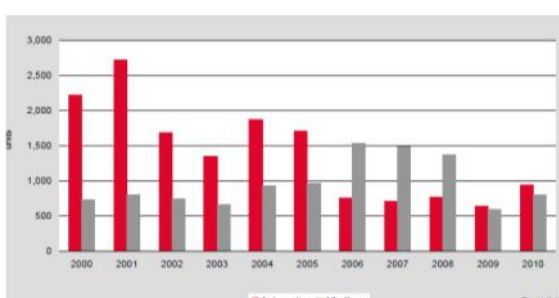
Germany



Italy



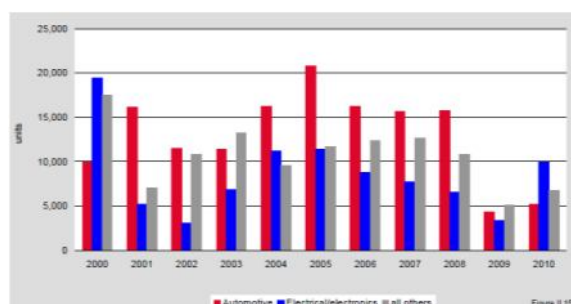
France



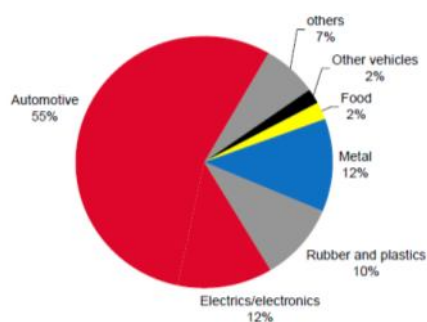
Spain

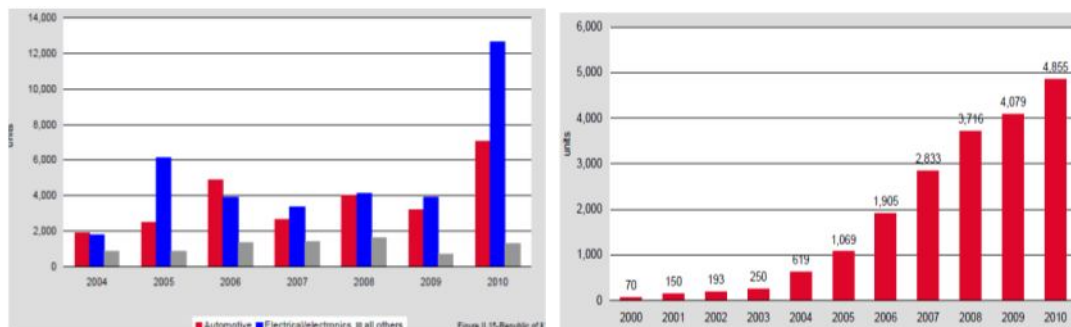
Figure 5. Application of industrial robot in European countries

The Figure 6 shows the industrial robot application in four Asian countries with developed automobile industry or is in the development process: Japan, China, Republic Korea and India [4,5,6].



Japan



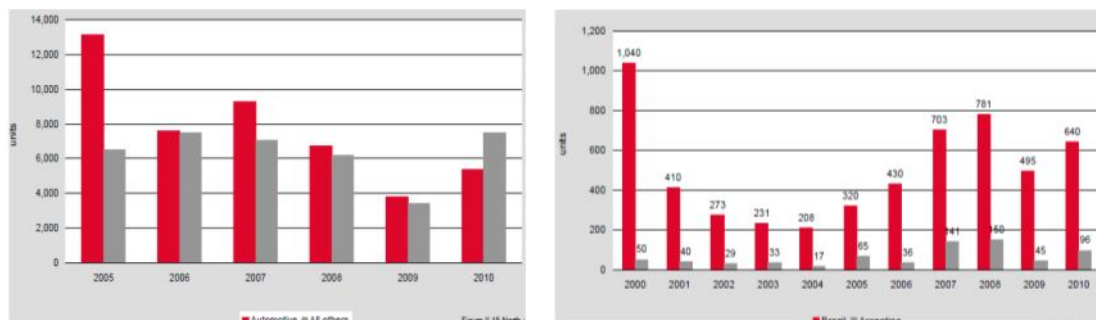


Republic of Chorea

India

Figure 6. Application of industrial robot in Asian countries

The Figure 7 shows the industrial robot application in American countries, with the developed automobile industry or is in the development process: USA, Canada, Mexico, Brazil and Argentina.



America (USA, Canada, Mexico)

Brazil i Argentina

Figure 7. Application of industrial robot in American countries [5]

According to the Table 4 with the analyses carried on only for leading countries, considering the industrial robot application in different industrial branches, the conclusion refers that the highest number of installed robots in automobile industry is in: China, Republic Korea, Germany, North America and Japan. When it comes to Europe, the fall of industrial robot application in automobile industry is evident in Germany, France and Italy till 2009. In 2010, the trend increases, but in Spain the declining trend still continues to exist. In Asia, the highest number of robot application exists in China with 8.300 units, presenting 20% of the total robot application in automobile industry. This country increases its investment in automobile industry manufacturing capacities and also automation and modernization of manufacturing process, resulting with the increase of robot application. Countries like China, India, Thailand, Malaysia and Taiwan [3, 4, 5] are increasing their involvement in automobile industry by partaking in industrial robot application. In motor vehicles industries like Western Europe, North America and Japan the industrial robot application declined in the past few years considering the automobile manufacturing tradition. After the continuing fall of the industrial robot application in automobile industry from 2006, in 2010 it becomes the biggest robot application consumer with 70% more robot applications then in 2009. Concerning the annual robot application,

the automobile industry takes 35.86% in 2010. We can compare the world industrial robot application by percentage, in the automobile and in other industries at the annual and at the total industrial robot application level in order to perceive the differences and dependences from industry to industry in 2010 and make conclusions. In figures 8 and 9 the robot application in all world industries for 2010 has been shown.

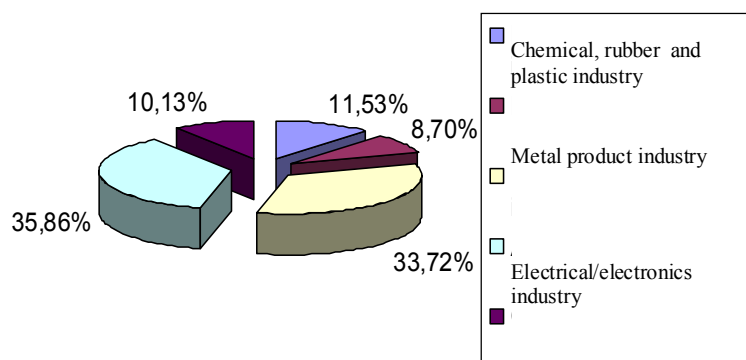


Figure 8. Percentage of annual supply of industrial robots in the World by industrial branches in 2010

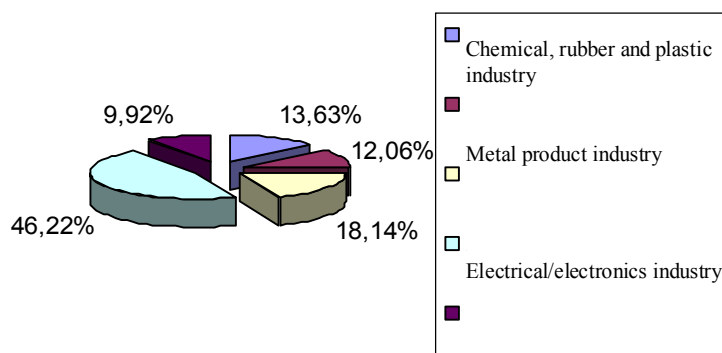


Figure 9. Percentage of operational stock of industrial robots in the World by industrial branches in 2010

From the percentage annual world industrial robot partaking in different industries in 2010, given in Figure 8, the first place in robot application takes automobile industry with 35, 86%, then electro/electronic industry with 33, 72%, and the third place takes plastic and chemical industry with 11, 53%. It is the same trend in world total industrial robot application, with different percentage partaking: automobile industry with 46, 22%, electro/electronic industry with 18, 14%, plastic and chemical industry with 13, 63%, and the fourth place takes the metal industry with 12, 06%. We come to the conclusion that the automobile industry counts the highest number of industrial robot applications at annual and at the world total level, in relation with the other industrial branches.

4. CONCLUSION

According to the presented tables and figures we come to the next conclusions about industrial robot applications in the world. The automobile industry invests in manufacturing process of industrial robot application and the highest robot number is applied in spot welding of automobile bodywork. The industrial robot applications in automobile industry vary till 2008. In 2009, the industrial robot application faced serious difficulties due to the world global financial crisis in 2008/2009, but in 2010 the robot application highly increased. The industrial robot application in most of the Western European countries in automobile industry faced with the declining trend from 2003/2004, but the lowest industrial robot application in automobile industry was in 2009. Even though the robot application in this industry was higher during a few years, the total number of the industrial robot application is still beyond the level that existed in 2003/2004. Consolidation of the automobile industry in Western Europe market left a mark before the industrial deceleration. Even though in 2010, the robot application in automobile industry was highly increased but still didn't reach the level before the world global financial crisis. Considering the automobile industry in Japan, the application robot trend constantly deals with the fall since 2005, although 2010 records higher applications in comparison with 2009. In Republic Korea, this trend constantly increases and culminated in 2010. In Asia, the biggest number of robot application is in China (8. 300 units). It presents 20% of total robot applications in automobile industry. It is obvious that this country invests in manufacturing capacities of automobile industry and also automation and modernization of manufacturing process, which increases robot applications. In order to increase their involvement in automobile industry, countries like China, India, Thailand, Malaysia and Taiwan are increasing their partaking in industrial robot application. From the annual world industrial robot involvement in different industries in 2010, the first place in robot application takes automobile industry with 35, 86%. The identical trend of involvement is in the world industrial robot application in automobile industry with 46, 22%, and takes the first place considering the other industrial branches.

REFERENCES

- [1] Karabegović I., V.Doleček (2003), Primjena robota u 21. stoljeću, 4th *International Scientific Conference on Production Engineering RIM 2003*, Bihać BiH, September 25th-27th 2003, (ISBN 9958-624-16-8), pp. 3-22.
- [2] Bakšys B., Fedaravičius A., Robotu Technika, Kaunas Technologija, Kaunas, 2004.
- [3] Rogić M., Industrial robots, Mašinski fakultet Banjaluka, Banjaluka, 2001.
- [4] Karabegović I., Karabegović E., Husak E., (2011), Comparative analysis of the industrial robot application in Europa and Asia, *International Journal of Engineering & Technology IJET-IJENS Vol: 11 No: 01*
- [5] World Robotics 2010, United Nations, New York and Geneva, 2010.
- [6] World Robotics 2008, United Nations, New York and Geneva, 2008.
- [7] World Robotics 2006, United Nations, New York and Geneva, 2006.
- [8] Karabegović, I., Jurković M., Doleček, V., (2005), Application of industrial robots in Europe and World, 30. Savetovanje proizvodnog mašinstva, Vrnjačka Banja, Serbia, pp. 29-45.
- [9] Doleček V., Karabegović I. Roboti, Tehnički fakultet Bihać, Bihać, 2002.
- [10] Doleček V., Karabegović I. Robots in industry, Tehnički fakultet Bihać, Bihać, 2008.
- [11] Nikolić G., Rogale D., Jerbić B., i dr. Robots, TTF Zagreb, Croatia, 2008.

- [12] Karabegović, I., Hodžić D.,(2010),Application scenario of robot industry,CENT, Bosnia nad Hercegovina, pp.31-40.
- [13] Doleček, V., Karabegović, I.,(2005), Robot distribution, 5th International Scientific Conference on production Engineering Development and Modernization of Production RIM 2005, Bihać B&H,pp.3-20-
- [14] Karabegović,I.,Doleček,V., (2007),Application of industria lrobots in automotive industry, 5.International Scientific Confernce on production Engineering Developlment and Modernization of Production RIM 2007, Plitvička jezera,Croatia, 24-26.oktobar 2007,pp.49-50.
- [15] Karabegović I., V.Doleček (2003), Robot application in 21th century, 4th *International Scientific Conference on Production Engineering RIM 2003*, Bihać BiH, September 25th-27th 2003, (ISBN 9958-624-16-8), pp. 3-22.
- [16] Karabegović I., Doleček V., M.Jurković (2010), Aplication of Industrial robots in small and medium sized enterprises, *1st International Scientific Conference on Engineering MAT 2010, Mostar 18-20. November* (ISSN 1986-9126), pp. 1-7.