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TRENDS IN THE DEVELOPMENT AND PRODUCTION OF INDUSTRIAL ROBOTS

The paper describes state of the development, production and utilization of industrial robots. It shows the fields of highest deployment of robots. The year 2010 was a break-through and since that year the production of industrial robots has increased each year. The paper also points out the increasing trend of use of service robots as well as mentions main producers and countries with high potential deployment of robots.

Keywords: industrial robot, service robot

Introduction

The year 2010 is known as the year of the comeback in the production of industrial robots. It follows from the fact that in 2009 there were a decline in the annual installation of robots in number of 60 000. But in the period 2005-2008 there were installed more than 100 000 industrial robots worldwide. However, in 2010 the number of installed industrial robots reached number 140 000 and from that of year there is increasing number of installed robots every year. In the year 2014 it was more than 180 000 installed robots according to the estimate of IFR (International Federation of Robotics). The assumption for year 2015 is to achieve a magical value of 200 000 installed industrial robots.

The dominant manufacturers of industrial robots in the world

The leaders in the development of robotics are Japan, USA, Europe and South Korea, fig. 1. USA dominates in service robotics for military use - off-road mobile robots type. They are unique in the development of robots for application in universe and interplanetary robots. Interesting is that USA does not dominate in the field of industrial robotics production despite the fact that the first robots were produced in USA (General Motors, Cincinnati Milacron, Westinghouse a General Electric). Well-known manufacturers of industrial robots in the USA today are Adept and San -Jose-based Company.

In Japan and South Korea there are widely developed activities of research and production of service robotics, where can be included also humanoid robots. They are mainly intended as robots for household, entertainment or rescue activities. It seems to be one of the most traded goods in next 10 years. Japan and South Korea also see another great potential in the development of robots for elderly care. And Japan is traditionally strong in the field of industrial robotics.

In the Europe there dominate the industrial robots. In the field of service robotics the main orientation is focused on mobile robotics for transport and logistics mainly in external environment (in urban environment). The second area is the robots intended for cooperation with humans. Europe is a leader in the manufacturing and deployment of industrial robots. In the Europe there are around 15 major companies producing industrial robots (KUKA, ABB, REIS, SCHUNK, STAUBLI, PROMOT, COMAU, CLOOS, FATRONIC).

In these dominant areas of robotics, there are several national and international programs for the robotic research. The USA accepted the document in 2009 entitled "Robotics and Automation Research Priorities for U.S. Manufacturing, where emphasizes that robotics is the key to the transformation of production to achieve a high level of competitiveness. In Japan, large companies have their own programs to develop new solutions and applications of robots. Also in Europe more research oriented programs in robotics are elaborated.

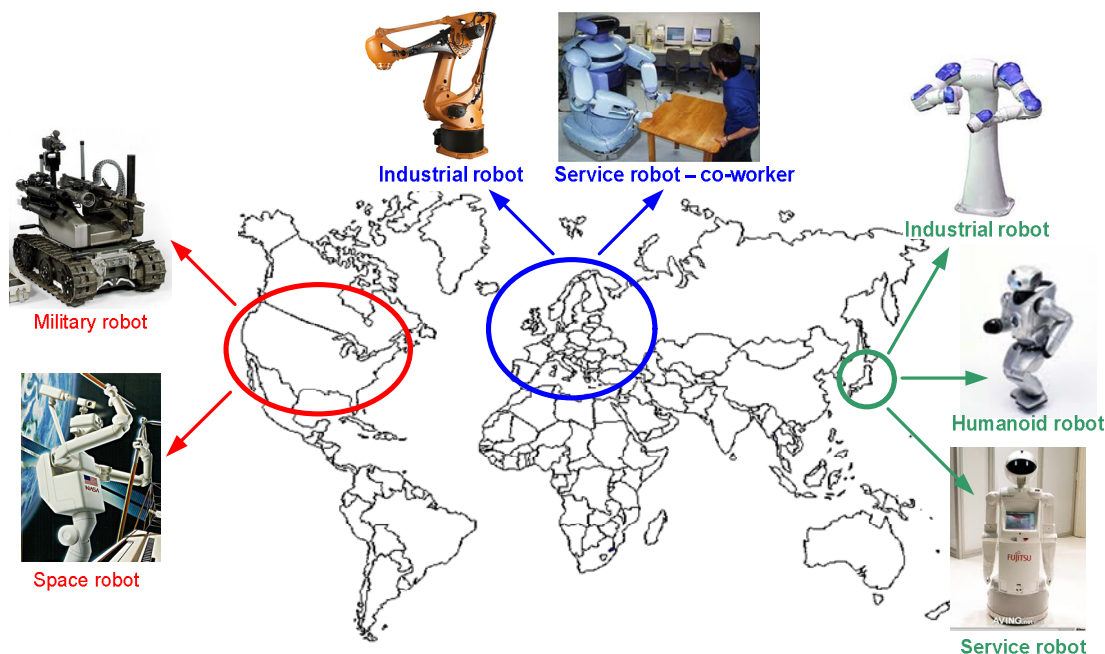


Fig. 1 The distribution of the global development of robotics

The growing trend in deployment of industrial robots

In the 50s until the early 90s the number of installed robots stood increase at twice every 3 years. In 1992-1994 there has been stagnation and statistics recorded up to 30% decrease compared to the forecast. The reason is stated the saturation in the traditional applications – welding, machinery operation. The reaction of the manufacturers on this stagnation was the robots price reduction, which resulted in possibility to robot deployment in small producers but also the replacement old robots with new.

In the following period there is changed an approach to the deployment of robots, robots were improved in the aspects of design, drives as well as in the control which caused the wider field of application. Between 2005 - 2008 the number of new application of robots was stabilized at around 100 000 robots installed each year. In 2009 there was a dramatic decrease to 60 000 installed robots. However the next year 2010 is already known as a strong return to the industrial robotics. This year there were produced twice robots compared to 2009. Subsequent years 2011 – 2013 there were increase in the 160 000 – 180 000 sold robots. The main reason of this sharp increase in the deployment of robots since 2010 is in particular the rapid development of automation to remain competitiveness, achieving higher production and quality assurance. In 2014 the number of deployed robots is little less than 200 000 and in 2015 it is expected to overcome the magical number of 200 000 robots, fig. 2.

The upward trend in sales is expected also in the coming years. This trend is based mainly on the dynamic market growth and deployment of robots in particular China, South Korea, ASEAN countries but also in Africa. In Africa were in 2013 sold more than 700 industrial robots, what is a increase more than 80% compared to 2012. In Europe there were sold 43 000 robots which is 5% more than in 2012. In America it was 8% more than in year 2012 i.e. 30 000 robots. More than half of all robots i.e. 100,000 were sold in Asia, Australia and New Zealand.

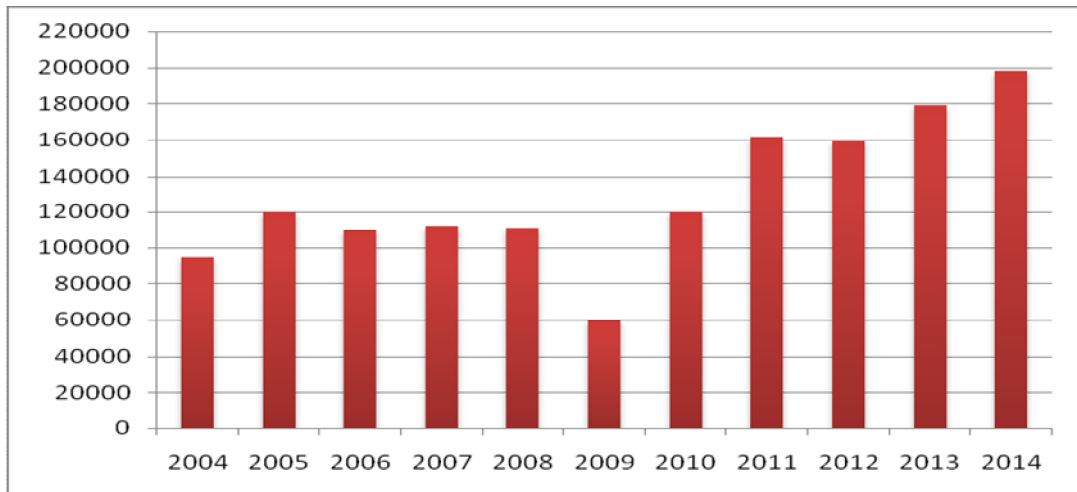


Fig. 2 Sales of industrial robots in the world in the years 2004 - 2014

The most important purchaser of industrial robots is traditionally automotive, electrical and metalworking industry. In 2013, the supply of industrial robots in the automotive industry increased compared to 2012 by 5% to a record 70,000 robots, representing 40% of all robots produced in 2013. Most robots for the period 2011-2013 was installed in China, Japan, USA, South Korea and Germany. The increase in the installation of industrial robots in that period was also in countries such as Taiwan, India, Mexico. In European countries the largest number of robot has been installed mainly in Italy and Spain.

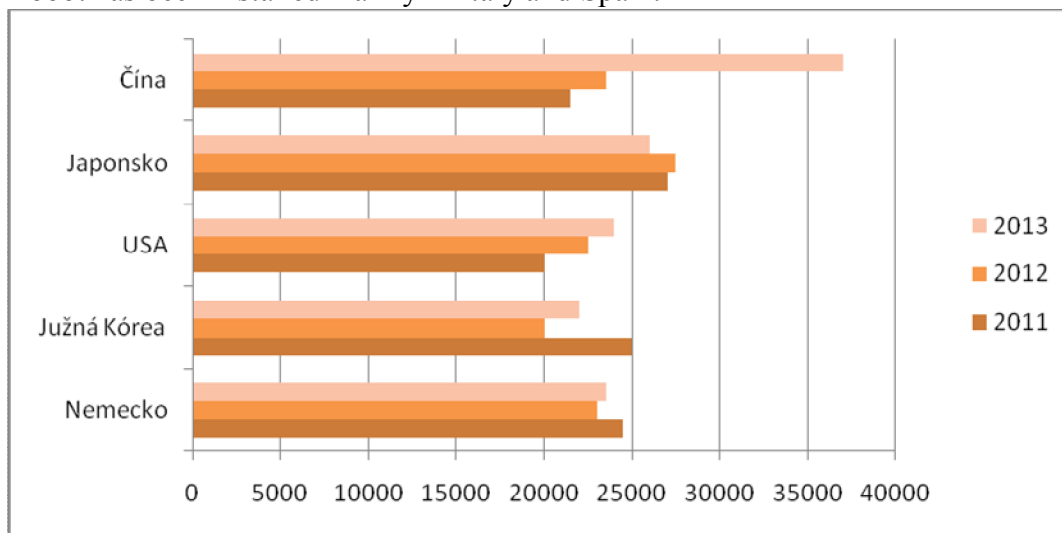


Fig. 3 Supply of industrial robots in the major markets in the world in the years 2011-2013

New areas of development and application of industrial robots

Development of industrial robotics abandons the individual and "isolated" deployment of robots and moves to a group building and deployment of workstation of type robot - human. Changes in the approach to the development of today's industrial robotics are shown in tab. 1.

Up to now	Now
• stabile industrial robot	• mobile reallocation
• periodic or repeated cycles with little changes	• frequently changed tasks, rarely repeated cycles
• individual activity of robots	• robots' cooperation
• on-line/off-line programming	• on-line task assigning
• no human-robot cooperation in the robot zone	• mutual human-robot cooperation on tasks
• efficiency at middle and higher series	• higher efficiency a lower series

It has been shown that the preferred way of deploying the robots of type one robot - one action has been inefficient. However, at the workplace there are much more activities identified as auxiliary such as the exact position of the object, withdrawal and many others, for which they were designed as a single-purpose device. At the current time of innovation, these workplaces do not meet the requirements. The solution is represented by the robots with automatically replaceable effectors, respectively technology heads or reconfigurable grippers as well as the use of multiple robots as a group with a common purpose and robots with multiple arms and increasing the autonomy of robots in more and more unstructured environment. Typical applications of multirobotic cells include welding systems in which one or more robots carry out welding and positioning and handling of weldments is executed by the other robot, fig. 4. The benefit is obvious. The advantage of such sites is that they can perform more of various activities.



Fig 4. Welding – typical application of multirobotic systems

From duo robots (Fig. 5) can be expected in the near future to go beyond the human ability, even in sensitivity, not only in strength, speed and accuracy. The basic idea of duo robotic development are human activities carried out with both hands for everyday handling and in collaboration with several workers.

In multirobotic systems and duo robots the establishment of activities, handling paths and synchronization of their movements and speed are new challenges. Key aspects of multirobotic systems are parallel control and synchronization and cooperation of their activities.



Fig 5 Dual – arm robot



Fig 6 Industrial Mobile Robot)

Conclusion

Robotics represents today one of the most dynamically developing fields. Wide application of robots is supported by their construction design based on modular principles allowing construction of various kinematic configurations of robots as well as its effectors.

By the 2017 it is estimated that in China will work more industrial robots than in Europe and USA. The assumption is that will be more than 400 000 industrial robots. In the USA the assumption is 300 000 robots and in Europe it will be 340 000 robots.

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