RECENT TRENDS IN INDUSTRIAL ROBOTICS

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Abstract

The article provides latest information about recent trends in industrial robotics, including actual news presented at AUTOMATICA 2014 fair. Overall shipment statistics, newly announced robots and upcoming technologies mostly in the field of robot human collaboration are included as well. The last section of the article summarizes information about current European innovation robotics research programme called SPARC.

Key words: world robotics, statistics, industrial robots, trends.

INTRODUCTION

According to International federation of Robotics, 168 000 industrial robots were sold worldwide in 2013 [1] which is 12% increase compared to year 2012 (Fig. 1). Incoming orders in first four months of 2014 increased remarkably and robot industry expect further rise in actual year.

Increasing production is caused mainly by higher demand by Asian countries, where almost 100,000 robot were installed last year. Total accumulated sales measured since the introduction of industrial robots at the end of 1960s, amounted to about 2,630,000 units by the end of 2013. An average length of industrial robots service life is 12 years and estimated number of industrial robots in operation worldwide is 1,500,000. South Korea reached the highest robot density in the world - approximately 400 robots per 10,000 employees.

The automotive industry is still the most important customer of industrial robots. The share of total supply is almost 40% and considering fact that statistical data from emerging countries are not complete, automotive share is probably even higher. The electrical/electronics industry reduced robot orders by 13% to 32,700 units. The share of total supply in 2013 was about 21%. Rubber and plastics industry has continuously increased the number of robot installations since 2009 from about 5,800 units to 11,800 units in 2013. Metal and machinery industry has declined by 3% to about 13,700 units accounting for a share 9% of the total supply (Fig. 2).

Industrial robot market expects continued increase in years 2014-2016. The demand will vary among regions and the industries. In certain markets such as automotive industry the demand will slow down after three years of continued increasing robot installations in traditional as well as emerging markets. The electrical/electronics industry will increase robot investments in production automation as well as in retooling for new production processes. A further increase of robot orders from other industries is also expected, particularly from the pharmaceutical, food and metal industry. Continued growth of robot sales is expected in North America, Brazil, South Korea, China and Eastern European markets including Turkey. Robot sales to Japan and Germany will probably decrease due to automotive market saturation, caused by large investments in recent three years.
LOW-COST, LIGHT WEIGHT AND COLLABORATIVE

An average industrial robot sold last year was most probably used for some kind of welding, painting or pick and place application, it was surrounded by fences and guards for safety purposes and it required authorized personnel with lot of programming skills to program robot movements and trajectories. Industrial robot vendors traditionally compete with each other in improving features as achievable speed, repeatable precision, power consumption and user friendly interfaces, while trying to comply with all standards and safety regulations.

But in recent years, in order to grow and diversify the market and bring sustainable solutions mostly for SMEs, robotic vendors are little by little focusing on development of whole new generation of industrial robots – collaborative robots.

The main feature is the ability to work safely alongside humans. It brings a lot of challenges since these robots must be not only compact, lightweight and dexterous, but they need to be equipped by integrated sensors and vision systems as well. Teaching by demonstration – instead of using deep knowledge of programming is preferable programming method. Moreover these robots in order to work safely require passive compliance or overcurrent detection to handle external forces and be able to avoid collisions. The majority of collaborative robots can also be moved around the factory floor with ease in order to make it do another task at another station. How to combine all these features together and keep price low enough to be attractive for SMEs, is the main question in current industrial robotic development.

NEW SAFETY ISO STANDARDS

Safety is often central to the debate in human-robot collaborative circles. Technology too often outpaces the safety regulatory bodies and standard development is still struggling to catch up. One of the biggest news in collaborative community is standard harmonization [2] - the latest international ISO 10218:2011 and US adopted ANSI/RIA R15.06-2012 have been globally harmonized and identify four types of human-robot collaborative operation:

- Safety-rated monitored stop
- Hand guiding
- Speed and separation monitoring
- Power and force limiting

Collaborative operation must satisfy at least one of these criteria to meet the standards. Interesting fact is that power and force limiting values (previous 80watt / 150N) were removed in most recent standards, since it has shown that it is not about the force that is being applied but it depends on what robot is doing and what kind of tool it has.

NEW COLLABORATIVE ROBOTS

Automatica 2014 will be remembered as the show where collaborative robots became mainstream, taking a lot of floor space in the robotic exhibit with lo of newcomers. Universal Robots used the show to release their collaborative robot version 3.0 with enhanced safety features, Roberta from Gomtec has got a lot of attention and KUKA demonstrated their iiwa as a leading collaborative robot in several use-case demonstrations.

UNIVERSAL ROBOTS

UR is the only manufacturer of lightweight robot arms, which already has a long lasting experience in wide variety of industries. UR has released their next generation of collaborative robots, keeping the same platform, the UR5 and UR10. Robots still have the same safe human-robot collaboration features, but with couple of add-ons. The addition of absolute encoders, adjustable safety features and an increased number of I/Os are the main upgrades for this lightweight robot. The main innovation of new generation of collaborative robots is the true absolute encoders. The device allows the robot to achieve faster start-up because its position is recognized immediately.

Another addition to the hardware is the redundant electronic board, so the robot can comply with performance level D according to ISO standards. The new safety features allow user to set the collaborative robot for each situation. Doing so, the robot can operate at different speeds depending on the context. For example, the collaborative robot can run full speed when working in conjunction with the CNC machine and slow down once it is working alongside humans. Configuration can be done on 8 different safety planes in space, which mean 8 different areas where the robot can change its parameters automatically. All the new features
have been certified by TUV tested in accordance with EN ISO 13849:2008 PL d and EN ISO 10218-1:2011.

GOMTEC - ROBERTA

The 6-axis collaborative robot from Gomtec, called Roberta, was designed to suit small to medium sized enterprises who want to achieve flexible and efficient industrial automation. The design was focused on building an agile and lightweight robot that could be easily moved around the shop floor. With the weight of 19.5 kg, it can handle 8 kg payload. This characteristic is due to the highly optimized weight and power servomotors, which for a given torque, reduces power losses by half compared to a conventional motor. This means that Roberta has lower energy consumption for the equivalent operation.

The software and firmware have been developed to simplify the programming and provide complete liberty to the robot. In fact, with the RoboCommander device, the 6-axes of Roberta can easily be moved to any point in the working area with any desired orientation, which means that the robot can always take the shortest route to its next desired position without passing through singularity points. This collaborative robot is delivered with graphical user interface software that is very intuitive to program. Roberta can also be fitted with a range of industrial controllers. Programming is done by demonstration, like most collaborative robots. The only difference is that the robot is equipped with an illuminated rotating ring. This device provides information about the different points or motions by showing a color-coded acknowledgement.

The robot can be fixed with specific gripper that is completely safe for human-robot-collaboration. In fact, because it is camera equipped, the system can detect the presence of abnormal objects in the robot gripper field of view. The end effector is also equipped by finger-tip force sensors, another safety aspect that reduces the risk of any bodily injuries. Roberta comes in 3 different sizes with payloads 4.0 kg, 8.0kg and 12.0 kilograms. This collaborative robot family has been launched at the end of May.

KUKA LBR

KUKA which intend to be the leader in collaborative robots released new LBR iiwa last year in Hannover as leading lightweight robot with seven axes is designed in analogy to the human arm. It can be operated in position or compliance control mode. This, combined with the integrated sensor systems, endows the lightweight robot with programmable sensitivity. Its high-performance collision detection function and integrated joint torque sensors in all axes make the LBR iiwa an ideal solution for delicate joining processes and allow the use of simple tools.

Its low weight, seven axis and streamlined design make it ideally suited to confined installation situations and allow easy integration into existing production systems. The LBR iiwa is available with payload capacities of 7 and 14 kilograms. KUKA thus offers the first and so far only, lightweight robot with a payload capacity of over 10 kilograms.

PROB ROBOT

The PRoB 1R collaborative robot was developed as simple user-friendly, easy to program robot. All devices that can support HTML5 and JavaScript including smartphones, tablets and laptops are able to control the different aspects and program the PRoB. The robot also supports ROS and can be programmed with all kinds of 4th generation software packages (Labview, Matlab/Simulink) as well as all major programming languages while software architecture is focused on adaptive behavior.
PRob comes with build in 2-finger gripper (PGrip 1) as a modular effector. It is possible to change these particular grippers using only 2 screws due to patented-protected interface that allows a mechanical and electrical connect-disconnect operation to take place. The end effector has a large operating range (60 degrees), which allows user to grasp bigger objects such as 1.5l water bottle.

PRob weighs only 10 kg and has an operating range of 700mm. Its payload is low at only 1.5 kg. Like most collaborative robots, the PRob includes soft material, rounded shapes, limited forces and stop functions. PRob can be integrated into actual working environment without any risks of injury to humans.

EUROPEAN ROBOTIC RESEARCH

Finally a lot of newcomers brings energy and innovation into the industrial robotics marketplace. It is very important since widening gap between research and robotics industry in recent years was too obvious and now it looks like the process has turned over. Some of the companies offer products with capabilities close to what was presented in some of their research projects, illustrating that robotics industry is gaining momentum in creating new products quickly.

ROS (Robot Operating System) is running under the hood in many of starting companies and some research projects that were presented in Munich. Willow’s vision of building an open source platform to speed up robotic development is becoming a reality.

SPARC

According to a press release, the European Commission and 180 companies and research organizations (under the umbrella of euRobotics) have launched the world’s largest civilian research and innovation programme in robotics. Covering manufacturing, agriculture, health, transport, civil security, and households, this initiative called SPARC is the EU’s industrial policy effort to strengthen Europe’s position in the global robotics market.

Robotics enables companies to continue manufacturing in Europe, where they might otherwise move operations to lower-cost countries. But the potential of robotics goes far beyond the factory: from helping nurses in hospitals to inspecting dangerous power plants and tedious farm work. Autonomous cars and drones are other examples of robots. Robot-based automation solutions are essential to overcome today’s most pressing societal challenges – from demographic change to mobility to sustainable production.

The initiative is expected to create over 240 000 jobs in Europe and increase Europe’s share of the global market to 42%. The European Commission will invest €700million and euRobotics will invest €2.1 billion.

The project was launched at the Automatica 2014 conference and SPARC is open to all European companies and research institutions. The first call for proposals related to SPARC are run under the pillar LEIT – Leadership in Enabling and Industrial Technologies of the new EU research and innovation programme Horizon 2020.

CONCLUSION

Automatica fair 2014 was an important event because of several reasons. First of all it has shown that robotics industry market is continually growing and further increase of demand is expected. Collaborative robots are becoming standard product of several robotic vendors even despite the fact that to reach full potential of robot human collaboration, a lot of development needs to be done in the future. But recent examples of innovation transfer from research to industry looks promising and in combination with newly launched innovative SPARC programme, European robotics has a great potential to become the world leader in robotics technology development.

References