New small robot broadens applications spectrum for industrial automation

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An industrial robot which is small enough to be installed in cramped places, powerful enough to handle heavy loads and agile enough to outperform most alternative solutions. Just such a robot is being launched on the market by ABB during the spring of 2000.

Since developing the very first industrial robot over 25 years ago, ABB has been a major player in the field of robotic industrial automation. Robots from ABB can be found throughout the automotive, foundry, consumer goods, metal fabrication and plastics industries. Elements common to the applications in these sectors are hazardous, heavy and/or repetitive work cycles. Common improvements are higher production capacity and higher, ie more uniform, product quality.

However, as industrial robotics have gained ever more acceptance, the lighter jobs have increasingly come into focus as feasible robot applications. The new IRB 140 from ABB takes this trend to a new level. Being only 80-odd cm high and fitting on a footprint of only 40 × 45 cm, it still has a handling capacity of 5 kg, 6 working axes and a great reach. In fact, its reach upwards is as high as 120 cm and outwards as wide as 81 cm. It can swing around a full 360 degrees and bend back all the way down. These specifications make it one of the most versatile and capable robots on the market 1.

With its motion speed of 2.5 m/s, acceleration of 20 m/s² and positional repeatability of 0.03 mm, the new robot is also, to our knowledge, faster and more accurate than any other robot of its size.

The above features, in combination with its mounting flexibility (it can be mounted on the floor, on a wall or be suspended upside

1 *The new industrial robot IRB 140 from ABB offers high load-carrying capacity, wide reach, rapid motions, accurate positioning, all in a small frame.*

down), give the new IRB 140 industrial robot advantages that are opening up new and exciting opportunities for robotic industrial automation.

Easy installation

IRB 140 is compact and can be floor or wall mounted at any angle, or be suspended upside down. With its wide reach and six working axes, it is also extremely agile. All this allows for maximum layout and installation flexibility.

Easy system integration

Through its controller, the robot can communicate with surrounding process equipment via discrete analog and digital signals or industry-standard field buses. By way of two Ethernet ports, it is also able to communicate with office PCs, eg for monitoring and software handling. All this means that the IRB 140 is ready to play its part in integrated production systems.

Easy commissioning

Like the bigger members of this robot family, the IRB 140 can be programmed in a number of ways, eg:

- With a PC, using the Windows-based ProgramMaker software development tool. This method is particularly efficient in the case of larger multirobot systems.
- With a dedicated, rugged, programming panel by taking the robot 'by the hand' and through all the required motions, recording all the points along the way.

Which method to use is a matter of personal preferences. Both are fast and easy in all situations, whether initial programming sessions or subsequent debugging/tuning actions. The two methods can also be combined to advantage, eg for initial programming on a PC and subsequent debugging/tuning with a programming panel.

Like all other ABB robots, IRB 140 is programmed in the RAPID programming language, a well balanced combination of simplicity, flexibility and problem-solving power. Its hierarchical and modular program structure makes it easy to create and debug any kind of robot control program. The already rich library of instructions and functions can easily be augmented with user-defined instructions, functions and procedures. It handles multiple tasks, interrupts and errors with ease, and combines speed with precise path-following capabilities.

Use of the same programming language throughout ABB's range of robots also means that once the user has learnt to master one robot, he has also learnt to master the others.

Four typical applications

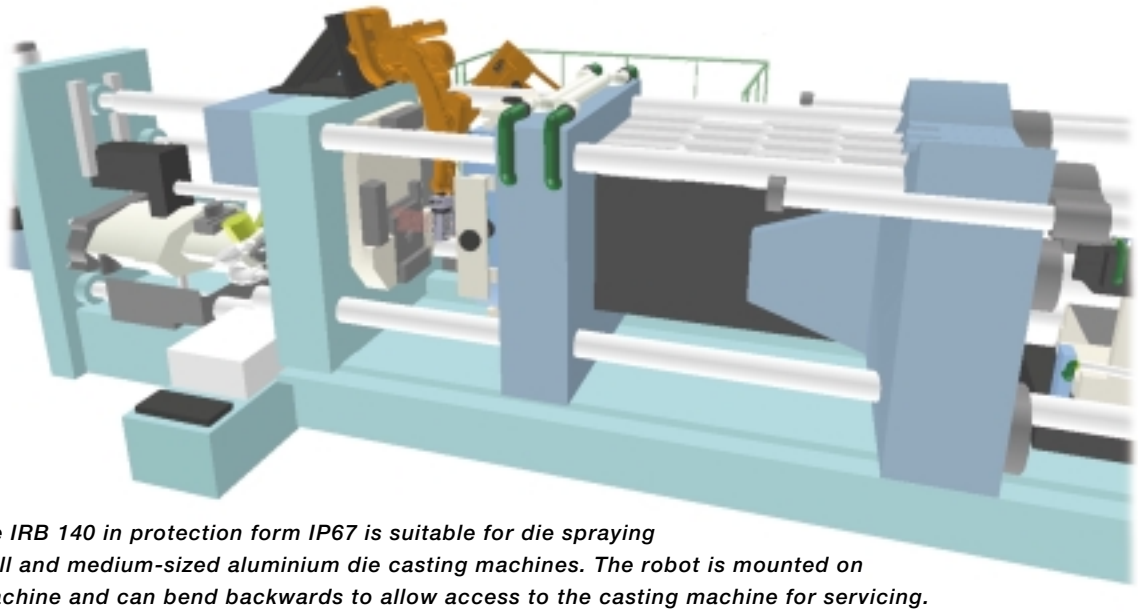
IRB 140 has been designed with the following typical applications in mind:

- Arc welding
- Aluminium die-spraying and deburring
- Small goods assembly, handling and packaging
- Machine loading, unloading and tending

Arc welding

On its own, the IRB 140 is amply suited to arc-welding applications, but to be able to offer even more utility to customers, ABB has developed a complete, self-contained, arc-welding cell based on the new robot 2. Called FlexArc Compact, the cell also incorporates a worktable, weld supplies and a cell management system. With a footprint of only 2.1 × 1.3 m, the skid-mounted cell is designed to fit quickly and easily into small spaces on existing production lines. It is a complete 'plug and play' unit that is easily transported from location to location on a standard forklift truck. There are single connections for power, gas and air so that the unit can be up and running in minutes. With FlexArc Compact, there are no extra costs for foundations, cable harnesses, safety equipment or testing.

2 FlexArc Compact is a self-contained, skid-mounted, welding cell, containing an IRB 140 robot and a cell management system. It provides immediate flexibility by eliminating bottlenecks and facilitating rapid change-over between jobs.



3 *The IRB 140 in protection form IP67 is suitable for die spraying in small and medium-sized aluminium die casting machines. The robot is mounted on the machine and can bend backwards to allow access to the casting machine for servicing.*

FlexArc Compact provides immediate flexibility by eliminating bottlenecks and facilitating rapid change-over between jobs. As such, it will appeal to manufactures who are faced with continually shifting production and retooling requirements.

Die spraying

Like many of its other family members, the new IRB 140 is available with foundry protection to IP67, not only of the wrist and the upper arm but of the entire robot structure, right down to the base, including all cables and connections. So it withstands hot metal spits and splashes, as well as high-pressure washing and detergent sprays.

A prime application for the IRB 140F is mold spraying, for which RoboSpray 140 is being developed. This is a complete robotic die spraying package, including a multinozzle spray head, a lubrication control system and SprayWare spraying process software.

The small physical size of the robot enables it to be shelf-mounted on the die casting machine in the optimum position. And it has the load-carrying capacity needed to handle the complex spray gun as well as the dexterity to move the gun around the most intricate of mold topologies 3.

ABB simulation software: user-friendly robotics

The rapid growth of robotics technologies has produced a need for software products that speed up configuration and maintenance. Most previously available robot simulation products have been limited to a few expert users, due to their high cost of ownership and the specialized skills required for use. New ABB software products are bringing advanced robotics simulation within the reach of every user.

ABB Digital Plant Technologies is a high-competence software division within ABB Robotics, headquartered in Gothenburg, Sweden. The group's mission is to develop and distribute software aimed at supporting customers throughout the total lifecycle of their manufacturing systems. First priority is given to products focused on computer-aided manufacturing simulation and off-line programming for flexible automation.

ABB has applied this concept to providing a digital model of a planned manufacturing system that is maintained in parallel with the real system throughout its lifecycle. This approach offers significant benefits to customers through a powerful series of robotics simulation software platforms.

Typical of the new ABB software is RobotStudio™, a PC-based 3-D simulation package that makes it possible to design and operate a new robot system before it is actually built. Utilizing an advanced 3-D model of the planned robot and a virtual copy of the robot controller, the software also tests suitability of fixtures planned for use in the system, verifies that the robot can reach all intended operating positions, and that overall cycle time

4 *Inverted IRB 140 robots to Clean Room 10 Standards are ideal for assembly and testing of small electronic goods. The robot is compact and therefore suitable for cramped production lines.*

Another application area for the IRB 140F is deflashing or deburring of die castings. ABB is working with partners to develop the FlexDeflasher cell for small components. This is a fully integrated unit with robot, deflashing tools, safety protection and application-specific software. Again it is the small size, high load-carrying capacity and 3D manipulative skills of the robot that make it ideal for this application.

Small goods assembly and packaging

The IRB 140 moves at high speed and with high accuracy. This, in combination with the compact design, the long reach and the mounting flexibility makes it ideal for assembly and testing lines for small electronic goods such as mobile telephones, radios, and for packaging applications. A Class 10 clean-room version of the robot has been developed with these applications in mind 4.

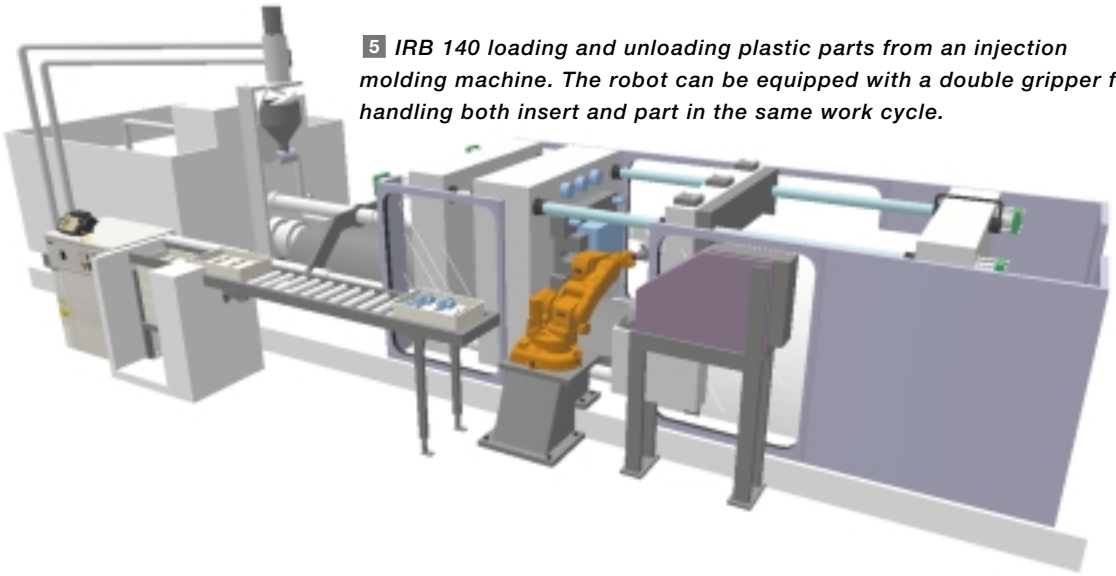
With its great load-carrying capacity, the robot is able to handle all the necessary tooling, even in multiples if required, to reduce cycle times and speed up production. Conveyor-tracking software enables the robot to

meets its target. Drag and drop programming permits quick construction of the simulator model without in-depth knowledge. ABB's RAPID robotics programming language, I/O configuration, and system parameters are fully supported by the RobotStudio model.

Complementing the RobotStudio platform are additional ABB packages for developing and maintaining multiple robot programs off-line on the PC, training of flexible automation personnel, and PC-based programs for robot tuning and operation. All utilize ABB's powerful Virtual Robot Controller, an exact digital replica of the real robotics system that is embedded in the off-line PC.

Through the use of these powerful tools, customers enjoy a competitive edge and reduced risk by evaluating new robotics strategies before the systems are even purchased. Product development lead times are shortened, as new robotics systems may be configured and debugged via the simulator as the physical equipment is being installed. Finally, plant flexibility is improved as new flexible automation scenarios and production changeovers may be configured and tested off-line via the PC without interruption of current production.

Complementing these powerful software packages, ABB offers a wide range of services to enhance the user's investment in flexible automation. These include automation consulting services to make the most of simulation software, round-the-clock technical support, and training services to familiarize customer personnel with new robotics strategies and their successful application.



5 *IRB 140 loading and unloading plastic parts from an injection molding machine. The robot can be equipped with a double gripper for handling both insert and part in the same work cycle.*

accurately synchronize its movements with that of the product passing by.

Machine tending

The new robot is perfect for tending small to medium-size plastic injection moulding machines. Its unparalleled mounting flexibility enables it to be installed in the optimum position on top of or to the side of the machine, or even suspended from an overhead gantry. Thanks to its 5-kg load-carrying capacity, it is not limited in the size of tooling it can carry; at full speed it can handle not only grippers for multiple impression parts but also 'double' grippers for loading inserts and unloading finished moldings in a single cycle, thereby contributing to increased productivity **5**.

The 6 axes and long reach of the robot translate into high accessibility around the mold, and its speed and precision guarantees precise and fast placement and pick out.

Software support

IRB 140 is supported by a wide array of software, enabling users to obtain maximum utility from their investment during both application development and normal operation. Some examples:

- *TrueMove* offers accurate, independent path and speed control based on dynamic modelling. It also offers a flexible and intuitive way of specifying corner zones (eg, the possibility to have separate zone sizes for the tool center point path and for tool re-orientation).
- *QuickMove* uses an advanced dynamic model to ensure the cycle times for the robot are always as short as possible. There is no need for manual tuning. This is achieved without compromising path accuracy.
- *Soft Safety Clutch*. Collision force-reduction software, protecting the workpiece, tooling and robot arm without having to install any additional hardware.
- *Load identification*. The robot can accurately identify the load currently held by the robot. No manual measuring or calculation is needed. The motion pattern during identification can be adjusted by the user to avoid collisions.
- *Typical control solutions* for typical applications. Software for getting the most out of the robot in typical applications in the shortest possible development time, eg ArcWare™, GlueWare™, SprayWare™, etc.
- *Simulation*. Simulation programs for the PC in which solutions under development can be examined on screen and checked for feasibility and cycle times.

The programs also facilitate robot programming and program adjustments.

Conclusion

The field of industrial robotics has come a long way during its three-to-four decades long history. During this time industrial robots have become ever more 'intelligent', agile, dextrous, compact, faster – and more cost-effective. This development has opened up ever more industrial applications to robotization, as the new IRB 140 from ABB ably demonstrates.

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