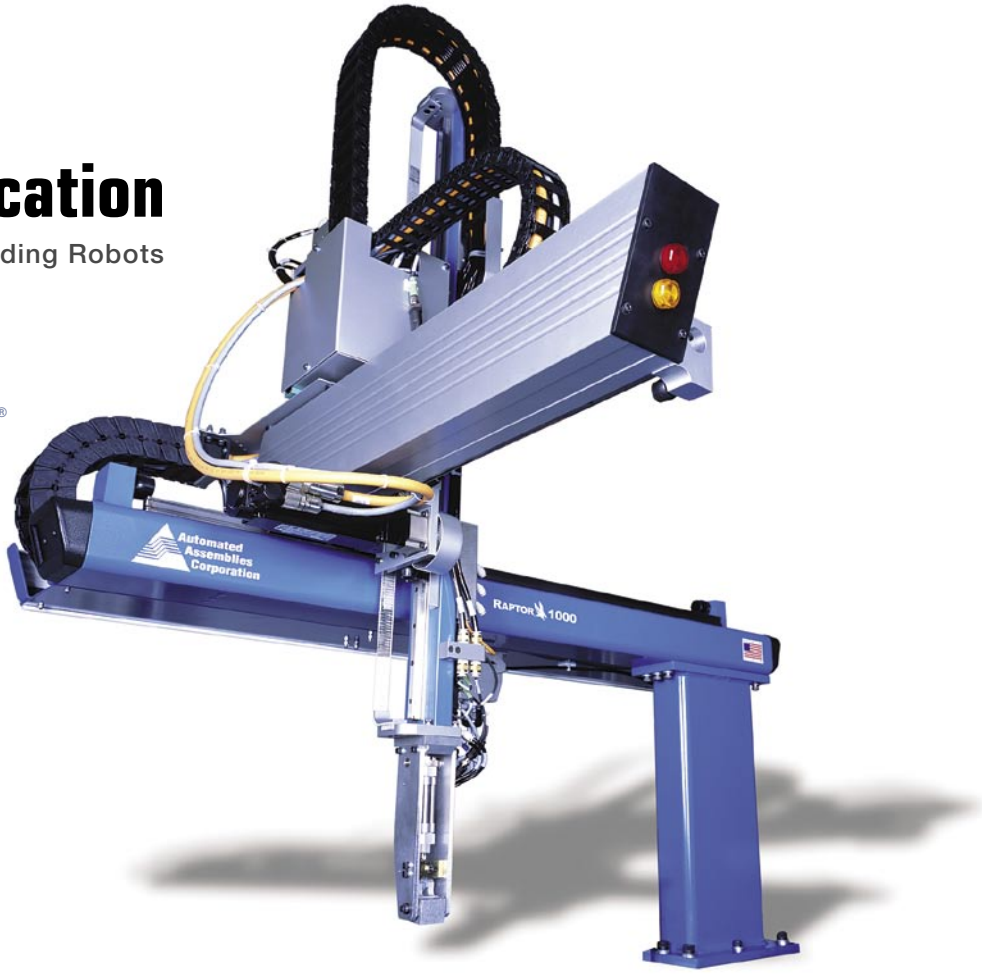
MEI® Motion Application

Injection Molding Robots

Automated Assemblies Corporation®

Raptor® Series Robots
with Intelimotion™

Injection Molding Applications



Automated Assemblies Corporation®

RAPTOR® Series Robots with Intelimotion™

SynqNet™ Performance. Motion. Network.

Target ELECTRONIC SUPPLY, INC.

AUTOMATED ASSEMBLIES CORPORATION® (AAC) is the first US company to design and manufacture robots to remove injection molded parts, and is leading the industry with some of the fastest top-entry industrial robots available today. In response to a growing need for faster, smarter, and easier to use robots, AAC embarked on a new injection molding robot design previously unseen in the marketplace.

AAC implemented an innovative and extremely aggressive marketing specification to not only build the next generation Raptor® robots from the ground up, but to also create a "Common Controls Platform" for future robot and workcell developments. The proposed schedule was to have a shippable product within one year from project inception. To help them with this aggressive schedule and next generation design, AAC contacted value-added reseller Target Electronic Supply, Inc. Based on the AAC marketing plan, Target saw a perfect fit for MEI motion control platforms and SynqNet™ all-digital performance motion network technology to satisfy AAC's Raptor specifications, as well as their critical Common Platform Development Initiative.

PLC to PC-Based Controls

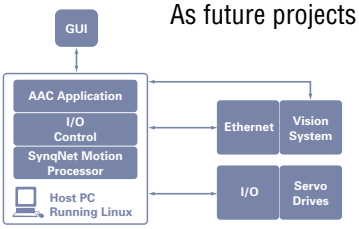
Previous robot controls from AAC were Programmable Logic Controllers (PLCs), and provided an adequate solution in terms of cost and ease-of-use. However, in light of AAC's vision to produce even faster robots and focus on enabling even greater automation in the injection molding processes, PC-based controls became the obvious solution. Modern PC-based controls with all-digital network connections are enabling a new generation of faster, smarter robots that are actually easier to use based on advanced Graphical User Interfaces (GUIs). AAC's goals included the development of a powerful yet intuitive GUI that would allow the end-user to quickly program Raptor robots or entire workcells from one visual workspace. This would enable the end-user to harness the power of modern computing power while actually reducing complexity. Based on a wide range of possible technologies and thorough evaluations, AAC chose an MEI SynqNet motion platform working with a Linux operating system for the Raptor line of robots. An XMP-SynqNet-PCI controller was chosen to control all the servo axes in the systems and the controller also provided an

mei® Motion Engineering

on- board CANOpen interface for general I/O as well. This initial configuration also laid the foundation for a Common Controls Platform for future robot designs.

Asset Utilization & Centralized Controls

Steve Braig, president of AAC points out that "Asset Utilization–how much of the workcell you can re-use after one type of product is finished and another starts without major change, is the key focus for the plastics industry." This concept of quick change-over and flexibility is especially critical to the profitability of custom molders who are typically experiencing shortened product life cycles, uncertain quantities of those products, and the pressure to add more value to those products. Braig continues, "The key for us then was to produce a common controls platform where a single PC-based controller could be utilized to expand workcell functionality and add value to the custom molder.



As future projects change, the molder would not be burdened with additional controls overhead and could easily modify the workcell with a minimum of expense. Flexible PC-based controls using MEI technology and the SynqNet digital network is a perfect fit for addressing this industry-wide concern."

Controls Functionality

AAC decided on a PCI based computer running Red Hat Linux as the operating system for the Raptor robots. Using MEI's SynqNet controller allowed great "flexibility out of the box," according to David Lee, Product Development Manager for AAC. "MEI's powerful software features and SynqNet motion network technology gave us a clear path to implement and build the Raptor lines. In addition, this technology will be key in future platforms as well."

SynqNet is used for all of the robots' servo control and can support up to 32 tightly synchronized high performance axes. This gives AAC plenty of flexibility for applications that call for additional end-of-tool servo requirements. AAC programmed with MEI's application programming interface, the MPI. The MPI is a powerful set of ANSI standard object-oriented C/C++ motion libraries that work with all MEI SynqNet type controllers. AAC then developed their very own compact Human Machine Interface for easy operation. The drag-and-drop touch-screen works to control and 'teach' the robot routines, as well as control Ethernet-based vision inspection equipment, conveyors, and additional workcell equipment that is needed for an application.

SynqNet™

SynqNet was selected for the AAC application based on a number of factors. Servo performance, reduced wiring, and reduced implementation time were primary reasons, but more importantly, cost vs. performance was a main driver in the AAC selection. As David points outs, "It's all about designing the optimum system to your specification as possible, and we saw many opportunities to reduce costs with the Raptor product line while increasing performance. We saw that centralized MEI controls and SynqNet digital network technology would greatly enhance performance while reducing system costs."

SynqNet is based on IEEE 802.3, and uses a standard Cat 5 cable and RJ45 connectors between controller and drives. The network is capable of torque update rates of up to 48kHz, and provides a high level of remote diagnostic capability that can be transported from the factory floor to enterprise via Ethernet on the PC.

A Raptor® 1000 placed on a 100-ton injection molding machine. Centralized PC-based controls gives the Raptor Series the highest asset utilization in the industry.

In addition to real-time remote diagnostics, SynqNet allows for configuration file download and firmware download over the network. For David Lee, "This was another exciting feature that we will continue to leverage going forward. To be able to update, or ensure that all installations worldwide have the appropriate, or most updated software versions is a powerful tool to say the least. This reduces the need for certain types of in-field support. And for on-site visits, there would be no surprises in terms of software versions, or hardware parameter settings."

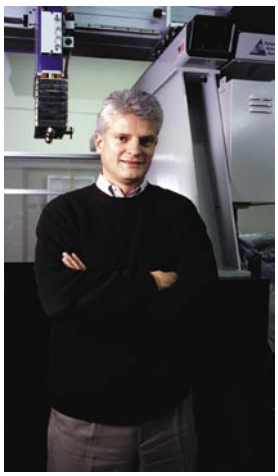
Time is Money

Production Time

Since there is only a single cable between controller and drives, the wiring setup and debug was performed on early prototype version of the Raptor in a matter of hours. Wiring simplicity and reductions help AAC deliver robots on a tight 4 week schedule. Additionally, due to the compact size of the controller housing, the machine intelligence can be placed in close proximity to the motors, further reducing cable runs from drive to motor. The innovative CAD design of the robot mechanics also helps decrease the time Raptor robot solutions can be delivered to market.

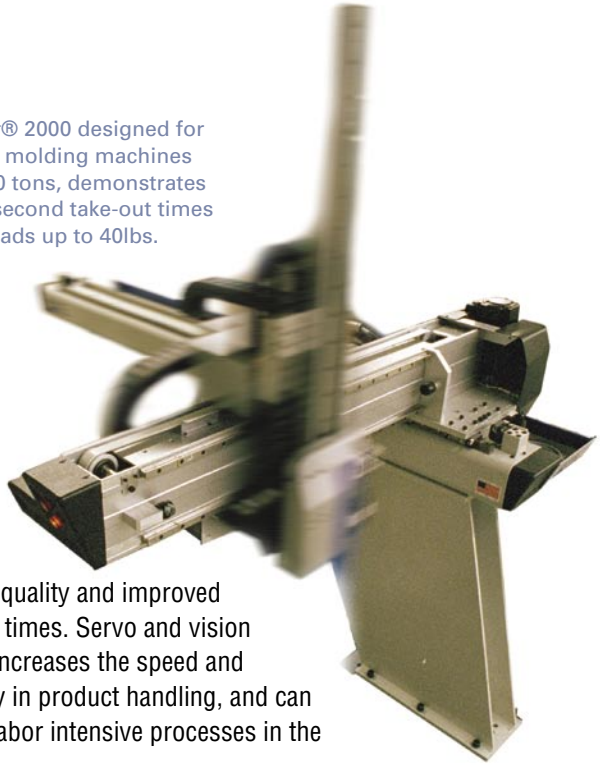
Injection Molding Cycle Time

"When the mold is open during processing, this is considered down-time," explains Braig. "The goal is to maximize the time the mold is spent making product, so this means reducing the time the mold is open each cycle. An obvious solution is to make the robot go as fast as possible. But we also see the key to maximizing throughput by the increased use of sensors and/or vision systems to check product integrity as the parts leave the mold. This is another key area where the performance of the SynqNet protocol coupled with a powerful MEI controller allows us to run faster than ever before and retain the flexibility to implement custom end-of-tool features." End-of-tool servo improvements like pressure sensors, allow for better overall product quality and improved take-out times. Servo and vision tooling increases the speed and accuracy in product handling, and can reduce labor intensive processes in the workcell.



"Our Raptor® Series Robots and complete Raptor workcells, combine all-digital controls, powerful software, and flexible tooling features to bring a best-in-class injection molding automation solution to the market...and we completed the whole Raptor project from inception to our first shipment in just under a year."

-Steve Braig, President AAC



A Raptor® 2000 designed for injection molding machines up to 700 tons, demonstrates 300millisecond take-out times on payloads up to 40lbs.

Automation for Efficiency

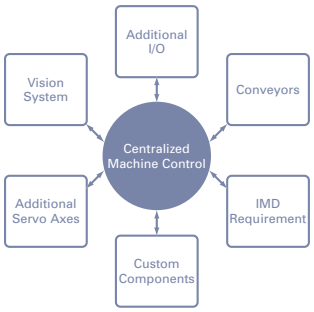
Braig sees a greater role for automation in the plastics industry that will help maximize efficiency. "Once the robot has a hold of the parts, inspecting the parts on the fly with 'smart cameras' tied directly to the PC, is an option with Raptor Vision Systems. The parts can then be placed directly into sorting trays and further packaged as part of a complete workcell solution. All this, and even more automated functionality is possible and cost effective due to a flexible centralized architecture where MEI controls and SynqNet fit perfectly."

Intelimotion™

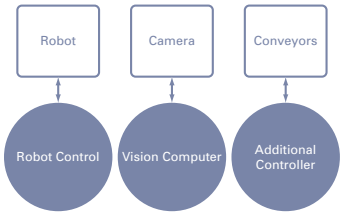
AAC has developed a novel technique to automatically adjust the speed and motion trajectories based on the type and weight of the part that is being extracted from the mold. Intelimotion™ is a patent pending technique that makes life much easier for the end-user as variation in products are automatically handled differently to ensure that the most efficient, and best quality product is produced. AAC has leveraged the power of MEI motion technology to develop an industry-first technique for dynamic handling of robot loads and the trajectories best suited for the load type and weight. The technology is transparent to the user, as it underpins the motion profiles used for programming the Raptor workcell via the drag-and-drop machine interface.

SPI Interface

Raptor robots communicate with other machinery via the standard SPI Interface. The SPI Interface is used in the plastics industry where it enables computers and plastics processing



Above: centralized controls allow for one platform on which to customize and/or change equipment easily for various product cycles. **Below:** in the past, various equipment required additional and often non-compatible control overhead, creating unnecessary cost and complexity.



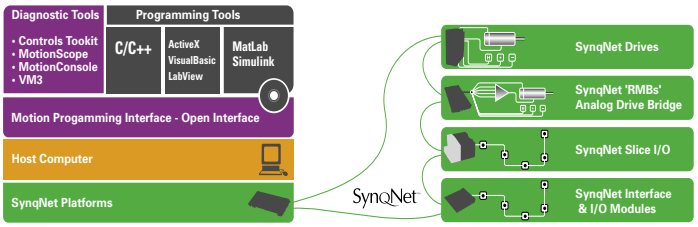
machinery to "talk" to each other electronically. Essentially, I/O from other machines can be captured by the MEI controller and integrated into Raptor programming schemes to work seamlessly with all other types of plastics machinery. All MEI controllers have dedicated user I/O, as well as options for SynqNet I/O and CANOpen I/O.

MEI Controls

The XMP-SynqNet series controllers feature an Analog Devices DSP for dedicated motion processing and feature a direct memory map architecture across the computer's PCI bus for efficient handling of tasks between host and controller. All XMP type controllers are programmed via the MPI, MEI's powerful C/C++ portable motion libraries. Other types of programming environments can be used such as ActiveX® and MatLab/Simulink® via MEI plug-ins. Sophisticated MechaWare™ servo control and tuning software utilities available from MEI also aid in compensating for mechanical anomalies and improving machine performance. In addition, XMP-SynqNet controllers contain the standard SynqNet interface that allows for daisy chain or ring topologies. SynqNet ring topologies allow for "self-healing" fault tolerant operation, so in the case of any cable fault between nodes, motion can continue via duplex communication from the controller. SynqNet is the only motion network available today that provides this level of safety and reliability.

One Software Investment

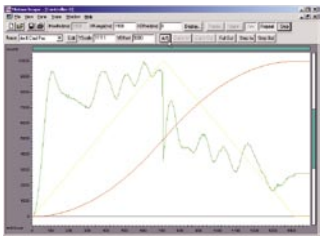
Since the MPI that AAC uses to program the Raptor robots is compatible with all MEI SynqNet type controllers, AAC is guaranteed a single software platform for continued development of motion control. The MPI is also platform independent, meaning that should AAC change PC type or operating system requirements on future robot lines, the MPI will be "portable" to other environments. In addition, the MPI supports CANOpen, so AAC did not need a separate CAN controller and was able to program both motion and CAN I/O under one programming interface. The MPI was key to AAC's Common Controls Platform initiative as it works across various operating systems, and in particular, Linux operating systems. AAC chose the Linux OS due to its solid reliability, portability, and to avoid obsolescence through the life of a robot which can average 10 or more years. Avoiding continued licensing contracts also allows AAC to extract cost from the system and pass that onto the end-user.



SynqNet Platform Overview

MEI Software Tools

In addition to the MPI, MEI provides several utilities to aid in programming motion. In particular, AAC was impressed with MotionScope™, a software utility that allows full graphing and analysis of real-time motion data. Position, velocity, and numerous other critical motion parameters are displayed real-time with the click of the mouse. Data recorder functions in the MPI that leverage the XMP hardware were a powerful tool for AAC in the remote use of MotionScope and for debugging software. As David Lee explains, "MotionScope allowed me to graph multiple real-time motion parameters during a move, and then compare the moves to help me determine quantitatively how I wanted to ultimately see the motion performed." Because the AAC application was developed under a Linux environment, David utilized the built in TCP/IP function of the utilities to do analysis over a standard Ethernet connection to a remote host running MotionScope. "This was an invaluable tool for quickly analyzing and improving motion performance."



The Design Cycle

When AAC finished the marketing specification for the Raptor robot, their goal was to have a product ready for shipping in just one year. AAC not only met that stringent goal, but demonstrated a complete prototype Raptor robot at the NPE show, "The World's Plastics Showcase" in June of 2003. The actual schedule was concept to prototype in just over six months, with product ready for shipment just three months later. Innovation as well as motivation coupled with a strong integrator relationship with Target Electronics, a value-added reseller, was instrumental in AAC meeting this goal. Outsourcing many integration aspects of the robot controls was not only cost effective, but choosing an MEI off-the-shelf motion platform allowed AAC to focus on other critical path aspects of the robot development.

Target Electronic Supply Inc.

When AAC approached Target with their next generation robot and need for a common controls platform, Target recommended MEI and SynqNet as a perfect match. As David Lee puts it simply, "Support from Target led to the success of the Raptor Line of Robots."

Core Competency

"You can consider us a "High-Tech Value-Add Reseller," says Les Peabody, Sales and Application Support for Target. "We provide a one-stop flexible solution for our customers, and support the most technically challenging applications."

For over 25 years, Target has been serving the New England area and providing custom, on-site support to many of their customers. They specialize in selecting and integrating power, motion control, mechanical, machine vision systems, and all types of accessories and products for a wide array of customers. Target also develops custom electromechanical products that best fit an application. As a stocking distributor, Target represents over 16 leading suppliers and emerging companies. Target considers that their ability to identify quality, innovative products has led to their success. Target serves customers in the semiconductor, medical, and packaging markets.

Integration Trends

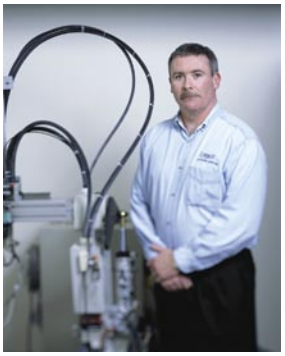
Target helps customers realize the best solution by offering a breadth of quality products from which to build that solution. Customers benefit from getting best-in-class products from a variety of world class suppliers, and gain from Targets value-added integration services. Customers can rely exclusively on Target to take responsibility for supplier products and varying degrees of integration support. Les also explains that their customers often look for a mix of quality standard products, and with Targets help, a means to produce their own differentiated machines as quickly as possible. "We are meticulous for pushing a system and seeing what the machine can tolerate no matter what the application might be." Target sees an increasing outsourcing trend as companies strive to reduce labor intensive areas in their design cycle and focus on their core competency.

Above and Beyond

"We help our customers from nuts and bolts to specifying drives and other power systems to integrating complete systems," explains Craig Deady, Applications Engineer for Target. "We also do quite a bit of in-house engineering, sub-assembly work, and further development. Our customers consider us an integral extension of their engineering departments. They can focus on their core competency while we remain flexible to ultimately help them reduce costs and get their product to market as quick as possible. MEI SynqNet products are a perfect fit for our customers interested in modern performance controls technology. Features like high-speed, all digital motion networking for wiring reduction, support for configuration file download over SynqNet, fault tolerance, easy field serviceability, remote diagnostics, and top-tier supplier support for SynqNet drives and I/O devices just to name a few," says Deady.

"MEI SynqNet products have been the fastest, most successful product introduction Target has ever experienced. The timing is right in the marketplace; the features of the all-digital SynqNet protocol, along with unique value brought to the table by Target is providing OEMs and other end-users a quick path to build next generation machines."

-Les Peabody, Target Electronics



According to Les Peabody, "MEI SynqNet products have been the fastest, most successful product introduction Target has ever experienced. We are pleased to offer MEI technologies to our customers. We also look forward to continuing our relationship with AAC by providing tenacious support and solid engineering services."

For more information:

Automated Assemblies Corporation
www.aac-robot.com

Target Electronic Supply, Inc.
www.targetelec.com

Motion Engineering, Inc.
www.motioneng.com

SynqNet™ Technology
www.SynqNet.org

Companies in this article:

Automated Assemblies Corporation

25 School Street
Clinton, MA 01510
+1-978-368-8914
www.aac-robot.com

Target ELECTRONIC SUPPLY, INC.

Main Office
Westwood, MA 02090
+1-781-329-2700
www.targetelec.com

Motion Engineering Centers

USA
Motion Engineering, Inc. Headquarters
Santa Barbara, CA
ph +1-805-681-3300 fax +1-805-681-3311

Silicon Valley
Palo Alto, CA
ph +1-650-319-0371 fax +1-650-319-0376

Southern California
Mission Viejo, CA
ph +1-949-348-2737 fax +1-805-681-3311

Boston
Acton, MA
ph +1-978-264-0051 fax +1-978-264-0057

Philadelphia
Philadelphia, PA
ph +1-215-793-4220 fax +1-215-793-4223

Japan
Motion Engineering, KK
Tokyo, Japan
ph +81-3-5540-6431 fax +81-3-5540-6432

Nagoya
Nagoya, Japan
ph +81-532-45-3511 fax +81-532-45-5415

UK
Motion Engineering, Ltd.
Bristol, UK
ph +44-117-3179-333 fax +44-117-3179-303

Germany
Saarbrucken, Germany
ph +49 681 85 79 96 5 fax +49 681 85 79 96 6

www.SynqNet.org
www.motioneng.com
info@motioneng.com

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