Uncommon problems, common solutions

The ultimate demonstration of a solution's portability and modularity is its successful deployment in an application its designers never dreamt of. The following block of articles takes a quick, but by no means exhaustive, tour of common ABB products in uncommon applications. Such solutions extend from the unusual to the downright exotic. The requirements placed on them are the same as in traditional markets – energy savings, quality and productivity. The magnitude of savings is often smaller than in standard solutions, but their significance for the customer sometimes greater.

On track with power savings

The cost of running one of Britain's largest tourist attractions looks set to fall. The introduction of power correction equipment from ABB at the Blackpool Pleasure Beach has reduced power consumption on new rides by around 25 percent, thrilling the operator as much as the customer.

Blackpool, on the north-west coast of England, is one of Britain's most popular holiday resorts. It is famous for its scale copy of the Eiffel Tower, its winter illuminations and the year-round entertainment of its Pleasure Beach. The Pleasure Beach attracts over 6.2 million visitors every year, all clamoring for the excitement of its famous rides.

Power consumption is a major challenge for a leisure facility that is constantly adding new power-hungry rides. With its latest addition, the dramatic "Bling" ride, which opened in 2004, the owners of the park looked to ABB to help them deliver the necessary electricity without having to undertake an upgrade of the overall power network supplying the Pleasure Beach.

This was not the first time that ABB had used its power factor correction (PFC) technology to help the park in this way. The first time was several years ago, when Blackpool first unveiled "the Valhalla", which, at the time, claimed to be the biggest and most spectacular dark (indoor) ride ever built.

The latest ride takes its name from the world of pop culture, "Bling". The white-knuckle experience involves a 95 kilometer per hour spin in three different directions, up to 30 meters above the ground, exposing riders to pressure two and a half times the force of gravity.

The "Bling" ride places major demands on the three-phase power network. It was expected to draw around 1,400A per phase, but with the installation of ABB's power factor correction equipment (a bank of capacitors totaling 300 kVAr) the supply current needed was reduced to 1,200A per phase. This means the power needed to operate the ride was cut by approximately 25 percent.

With total energy savings running at up to $3,800 per month in the peak season, the ABB equipment is expected to pay for itself within three years.

It was a similar story in terms of power and monetary savings when the Valhalla ride opened in 2000. Following the installation of the ABB automatic power factor correction equipment, which comprised two banks of capacitors totaling 900 kVAr, the supply current was reduced to 1500 A per phase. This meant that the power required to operate the ride fell from 1.5 MVA to a little over 1 MVA.

Karen Strong
karen.strong@gb.abb.com

Clean snow from a clean network

The equipment driving artificial snow cannons and mountain cable cars can interfere with power grids and result in flickering lights and poor television reception. But ABB has the perfect solution: network power quality filters (PQFs) for existing systems, and integrated supply unit (ISU) frequency converters for new devices.

Most artificial snow machinery and mountain cable-cars are located at the ends of valleys where the power grid is generally weaker. Unless appropriate counter-measures are taken, when the machinery is switched on, disturbances often occur in electricity-supply networks.

The asynchronous motor with 4Q frequency converters is also successfully used in pump drives.

Simultaneous individually programmable filtering is provided for 20 harmonics up to the 50th harmonic frequency. Filtering efficiency is typically better than 97 percent.

Network filters for existing artificial snow equipment

Older drive pumps on artificial snow machines are often fitted with conventional power converters that cause disruptive harmonics in the electricity supply system. ABB's goal was to eliminate these disturbances with a special network filter. The filter can be connected to existing drives or integrated into new systems with minimal effort.

These power quality filters (PQF) continuously monitor line current, in real time, to determine which harmonics are present, and then inject compensating currents into the network whose harmonics have exactly the opposite phase. The harmonics cancel out, leaving a clean sine wave.

Power Quality Filters are unaffected by changes in network parameters and cannot be overloaded. They are available in standard versions for 70, 100 and 130 A, and in other versions (ranging from 40 to 3,600 A) on request. They are already being used successfully in a variety of artificial snow systems.

Factbox The principle of the active filter

The principle of the active filter is to measure harmonic currents and actively generate a harmonic spectrum in opposite phase to the measured distorting harmonic current. The original harmonics are thereby cancelled.

The active filter has a parallel configuration, and monitors all three phases of low voltage line current in real time by means of a digital signal processor (DSP).

The output of the DSP unit, in combination with a microcontroller-based control system, generates a pulse width modulated (PWM) signal in order to control power modules based on IGBT (insulated gate bipolar transistor) technology acting as a current source. The PWM signal uses a fixed switching frequency.

The system operates under closed-loop control with a maximum response time not exceeding 40 milliseconds. The control system prevents the active filter from becoming overloaded.

Simultaneous individually programmable filtering is provided for 20 harmonics up to the 50th harmonic frequency. Filtering efficiency is typically better than 97 percent.

The operating power factor of the active filter is programmable over the range 0.7 inductive to 0.7 capacitive. The programmer may select both fixed and dynamic reactive power compensation.

The active filter is protected against overcurrent short-circuit, thermal overload and IGBT bridge abnormal operation.

Ingenuity at large

Asynchronous motor for new systems
Five years ago, ABB came up with a brilliant idea for new cable car installations: the four-quadrant asynchronous drives. Compared to DC drives, these new three-phase AC drives are smaller, require minimal maintenance and save energy. They have very low current harmonics, no reactive power consumption and can easily handle voltage surges in the grid. The frequency converter makes start-up and operation a breeze, and eliminates the need for complicated and time-consuming measurements.

Power Quality Filters are unaffected by changes in network parameters and cannot be overloaded.

The PQFM power filter can be connected to existing systems as an individual component with minimal effort

This technique is now being applied to the pump drives of artificial snow cannons, where the problems are similar: collector problems in the DC motors, as well as mains harmonics and reactive power in the thyristor controllers.

Here, too, the solution was an asynchronous motor with an ISU-FU integrated supply unit and frequency converter. This was first used, to great effect, at the 2003 Ski World Championship in St. Moritz, Switzerland. Other snow-making systems followed in the Swiss ski resorts of Laax, Flumserberg and Ibergeregg, and for the 2005 Ski World Cup finals in Lenzerheide. The result: mains harmonic filters and compensation systems are no longer needed in pump drives ranging in output from 200 to 355 kW.

Ueli Spinner
ueli.spinner@ch.abb.com
Jürgen Reese
juergen.reese@ch.abb.com

Oiling the wheels of an olive press

Olive oil extraction is a complicated business. ABB is working with Rapanelli Fioravante to provide an innovative solution for automated machine control.

In continuous-cycle mills, the painstaking steps of olive oil extraction – crushing, kneading, decanting and separating water and olive residue from the oil – are performed in automated production systems with little operator intervention. While this brings numerous advantages over more traditional methods, olive oil production – unlike other oil extraction systems – still requires precise control of the temperature and kneading time.

The system can be monitored from remote stations through common transmission networks, for management, control and maintenance purposes.

In order to improve the systems used by olive oil makers, Rapanelli Fioravante Spa of Foligno, Italy – a manufacturer of olive oil extraction machinery – has been working with ABB to design and implement an innovative solution for automated machine control.

The new solution allows the three units comprising the mill to be controlled individually. These are the crushing/kneading group; the decanter (centrifugation of the paste consisting of olive residues and oily must); and the end-separators, for removing excess water from the oil.

Supervision software provides details of work sessions, date and time, kneading time, and product temperature through all operating phases.

ABB's AC31 programmable logic controllers are used in the new system and software adaptations can be made to meet the needs of each individual oil producer – for instance, to accommodate the number of decanters or separators used in a particular configuration.

Individual processes within the oil-producing system can also be changed very easily. The system can be monitored from remote stations through common transmission networks (telephone, internet, etc), for management, control and maintenance purposes.

The Rapanelli company of Foligno worked with ABB on the design and implemention of an innovative solution for the control of automatic mills

Each of the three units in the mill has specific control software. In addition, two types of supervision software are available for controlling machine operation. These generate reports, providing details of work sessions, date and time, kneading time, and product temperature through all operating phases.

Temperature monitoring and sampling can be carried out through each stage of the operation, thanks to the system's ability to identify the exact position of the product in the production cycle.

All of this information is presented to the operator on a general display page. From here, work pages can be accessed and dedicated to each of the three operating units that make up the system. All control activities can be documented in detail.

Silvio Della Casa
silvio.della.casa@it.abb.com

A straight "torquing" formula

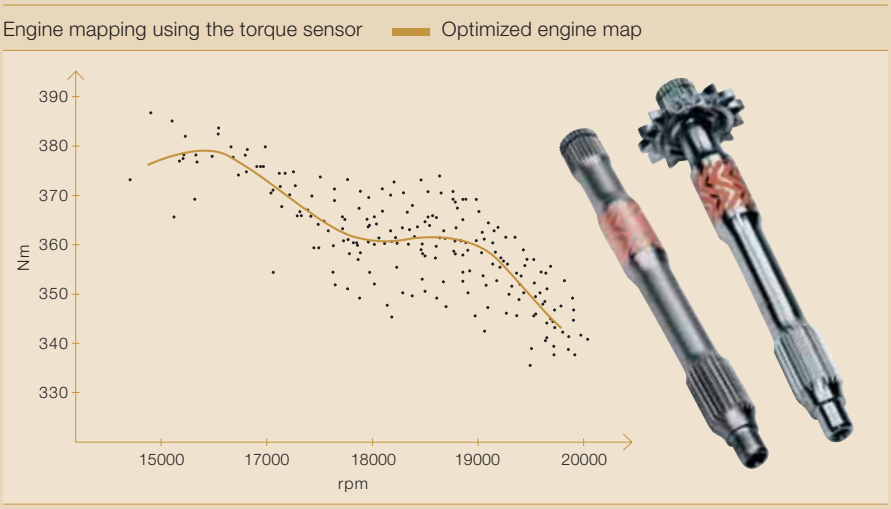
ABB has developed a torque sensor that can withstand the unforgiving environment of a Formula-one racing car.

The robust concept was originally developed for standard automotive applications and then adapted for extreme uses such as those found in Formula One installations. The sensor is small enough to be integrated directly into the power train on the gearbox input shaft. From here it has access to the actual engine torque, allowing a range of applications to be performed in terms of engine and drive train monitoring. An engine 'map' can be acquired directly, while the car is on the track, allowing the performance of gearshifts to be measured and optimized.

The conditions of Formula One racing are indeed demanding. For an installation on the gearbox input shaft, the sensor has to endure:

- Rotational speeds up to 20,000 rpm
- Temperatures up to 250° C
- Stress levels up to 1800 MPa

Other requirements include tolerance for high-level vibration, resistance to lubricants and a durability that en-



sures flawless operation, lap after lap. The sensor is also required to maintain its function without any special attention or recalibration, before or after the race.

When a ferromagnetic material is subjected to torque, its magnetic properties change. These changes (magnetoelasticity) can be measured and are the basis for ABB's Torductor-S, a non-contacting torque sensor used in the Formula-One cars. The sensor's ability to record data accurately and consistently in the harsh environment of a racing car makes it a unique and powerful tool for the optimization of engine performance. Correct tuning of the control system, which involves adjusting the engine to achieve maximum torque and power output, relies on detailed knowledge of the engine's output, as does the optimization of gearshifts for minimum torque interruption.

Engine tuning is usually carried out on a test rig before the engine is mounted in the racing car. However, experience has shown that conditions in the test rig do not entirely reflect those in the vehicle. This leads to sub-optimal tuning and sub-optimal performance. By positioning a torque sensor in the input shaft of the gearbox, it is possible to gather detailed information about the engine and the power train, while the car is actually racing. This allows an engine to be tuned to race conditions and allows performance to be monitored throughout the race.

When a ferromagnetic material is subjected to torque, its magnetic properties change. These changes can be measured and are the basis for ABB's Torductor-S.

In addition to measuring maximum output, the torque sensor also provides details of engine and gearbox performance, including engine response to driver input and equipment wear. In this most competitive of fields, reliable torque sensing is a most desirable feature.

Lars A. Gustavsson
lars.a.gustavsson@se.abb.com

Automation moulds a competitive edge

A leading manufacturer of custom-molded plastic novelties, Characteristix Limited, has doubled its manufacturing performance with the installation of an ABB robot-based cell at its factory in Wadebridge, Cornwall, UK.

The GeKu manufacturing cell – comprising an ABB six-axis IRB 140 robot, Krauss Maffei plastic injection molding machine, GeKu beam robot, conveyors, and pneumatic printing press – is helping Characteristix to remain competitive, even when pitted against the Far East giants of the industry.

Characteristix, which has a prestigious list of license partners such as 20th Century Fox, BBC Worldwide, Disney, Universal Studios and Warner Bros, has exploited a niche in the market to supply quick turn-round, small-to-medium size batch products to UK and European-based customers – companies that would previously have placed their orders in the Far East.

Not only does Characteristix offer a total turnkey approach, including design and artwork, but its fast production also gives customers the flexibility to order relatively small batches for speedy delivery.

This compares favorably with supplies from China, for example, where customers are restricted to ordering extremely large batches, can expect three month lead times, and need to closely examine quality and product suitability before proceeding.

A small enterprise, based in rural Cornwall with 11 employees, may not seem the most likely of companies to install robots and take on the Far East.

The GeKu manufacturing cell has doubled production to 33,000 pieces a day, including birthday card badges, stand-up figures, pendants, figurines, pencil toppers, fridge magnets and plastic paper clips etc, molded in the unmistakable shapes of famous cartoon characters like Bob the

Builder, Spiderman and Shrek, to name but a few.

Not only has the cell ramped up production for the Cornish badge maker, but it has also brought interest and variety to much of the production work force. Many of the company's employees, who were previously employed in manual labor, have risen to the challenge of robot-based manufacturing, readily participating in robot programming and operator tuition to enhance their skills.

Summing up, director Andy Knight comments: "A small enterprise, based in rural Cornwall with 11 employees, may not seem the most likely of companies to install robots and take on the Far East. However, the GeKu-designed cell and its ABB robot have helped us to be ultra-competitive, while we have maintained and indeed expanded a client-base made up of some of the most recognized names in the world."

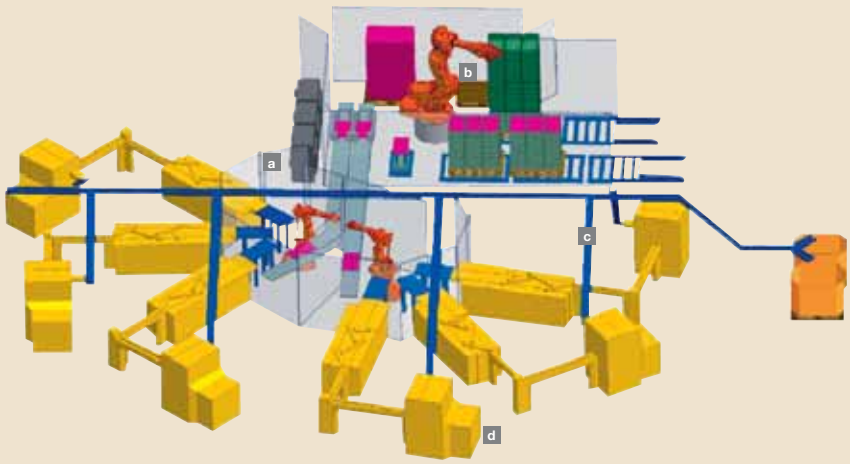
David Marshall
david.marshall@gb.abb.com

Toblerone – handled with care

Is there really anyone out there who hasn't heard of Toblerone, the most famous brand of Swiss chocolate? The unmistakable triangular chocolate bar is produced by Kraft Food Schweiz AG in Bern. Now available in individual portions, Toblerone chocolates are handled and individually packaged by ABB robots.

People around the world love Toblerone. Its shape – modelled on the most iconic of Swiss mountains, the Matterhorn – is unmistakable. What's new is that the three-cornered chocolate is now available in individual pieces. These can be

1 The Toblerone packaging system



a Transfer station
b Unload station
c Product collection and merging
d Wrapping machines 1–5 (spare machine 6)

enjoyed one at a time, with a coffee or as a little between-meal snack.

ABB robots work on the production line at Kraft Food, stacking full trays of individual chocolate triangles and 'feeding' them into the downstream packaging systems, where each one is individually foil-wrapped 1.

Kraft Food's goal

Kraft Food asked ABB to provide them with a system that would:

- automatically feed chocolates to five foil-wrapping machines
- collect and merge the packaged products for placement in palette containers
- prevent damage to the product
- maximize access for monitoring, cleaning, service and maintenance tasks
- accommodate a three-shift operation
- use simple component design
- provide a simple operating system to accommodate frequent changes in personnel

An ABB IRB 6600 robot, with a reach of more than three meters, transfers each container to a separating station.

ABB's solution

ABB's design concept for the complex and strictly specified system paid particular attention to the transfer of the chocolates from trays to the feed conveyor for the wrapping machine. If the chocolates were to fall during this procedure, they would cause machines to shut down. The chocolates must be precisely positioned to ensure optimum wrapping performance.

ABB's solution divides the overall job into several subtasks

Containers carrying trays filled with chocolate pieces are stacked on pallets and sent to an unloading station. Here, an ABB IRB 6600 robot, with a reach of more than three meters, transfers each container to a separating station. The trays are removed from the stacks and placed, several trays at a time, on one of two unstackers 2. A conveyor belt below each unstacker delivers the lowest tray to a transfer station.

The tray is pulled from beneath the chocolates so gently that they end up precisely arranged on the conveyor.

Trays filled with chocolates are picked up by an IRB 2400 robot at each of the transfer stations. To enable individual wrapping, the chocolates must remain evenly spaced when they are transferred onto the conveyor. To achieve this, the tray is pulled from beneath the chocolates so gently that they end up precisely arranged on the conveyor. This handling process is much more precise than manual transfer and also prevents the product being damaged.

After wrapping, the chocolate pieces are picked up by bucket conveyors that merge the product on a central collection conveyor, which runs along the entire length of system. At the end of this conveyer, the chocolates are collected in a large container. The delectable Toblerone chocolates are then ready to be delivered all over the world!

2 Unstacking the trays of chocolates

Werner Erismann
werner.erismann@ch.abb.com