Inspection of packaging in automated production is crucial. Many lines operate without manning and periodic sampling can be unsatisfactory. Some products may be dangerous or just create a mess if the packaging is faulty. In any case it is not good for the image of the brand if the packaging is less than perfect. To achieve a high and consistent standard, vision systems may be the only technology to apply.

Crate Inspection

When the beer crates are returned to the brewery they are emptied and washed. After that, they pass several cameras where the condition of the crate is checked. The handles must not be broken and the general shape should be acceptable. Each bottle pocket must be empty and the bottom grid pattern free of defects and debris.

The brand name on the side of the crate is checked to verify that it is in a reasonable condition and to detect foreign crates that must be rejected. The brewery does not like to put their products in the crate of a competitor. This is a major problem in Denmark where the crates are made from the same mould and used to carry the Danish standard beer bottle.

When the first system was specified in 1985 we were asked to reject all crates with a sharp deformation of 1 mm. The system was programmed and tested on sample crates to achieve this. When it was put in operation it turned out that about 50% of the crates were rejected. The crates were not in as good condition as the brewery thought. Then followed an extensive research where the production was fed through the system and measurements and statistics were generated. On basis on this, and common sense, the systems were reprogrammed to achieve a sound threshold between good and bad.

For the beer crates this was a question of the geometry and particular where on the crate the defects were found. Defects at the handles were critical because it could mean a broken handle that could give injury when handled. The method developed in 1985 has been used in all the following systems delivered to the breweries.

Detecting and accepting the brand name was a little more difficult. It was no problem to distinguish between the different brands, but when is the appearance acceptable?

For 25 years JLI has worked with the University of Copenhagen where the Department of Psychology is doing research into the human vision. Professors Axel Larsen and Claus Bondesen have experimented with different mathematical functions trying to emulate the human perception. The algorithms were too complex to apply in the vision systems in the early days but today GPU’s can do the number crunching.

The technology is under development. It is the aim to use it as a general filter to

Statistics functions in the vision system are very useful for optimizing production.
be applied after pre-processing of the image in the many applications where the system has to judge if a product is “nice”.

**Cheese Packaging**

The cheese is placed in the transparent tray and the lid is welded. The cheese is covered with herbs and spices and the small particles can easily leave the cheese in the highly electrostatic environment. They jump around and land on the welding surfaces. The welding will not be airtight and consequently the controlled atmosphere around the cheese will be contaminated.

The vision system looks at the cheese in its packaging with background lighting. The weld is examined 360 degrees, and if it is found faulty the cheese is rejected and repackaged.

This system is one of our oldest installations, and has just now been taken down for service after 17 years on fault free operation. It probably inspected 20 million cheeses in its service life.

**Cardboard Box Inspection**

SCA Mölnlycke in Norway employs JLI vision systems to inspect boxes with panty liners. Panty liners are not picked up on the supermarket shelf if they have a dent in the side or if the flaps are not sealed properly. Even though the product itself is perfect, it is sold, like many other commodities, on outward appearance of the box.

The boxes are printed in strong colours, many of them pretty dark to the vision camera. It is difficult to follow the contours of the boxes when the surfaces are highly decorated. To improve the image a Near Infra Red sensitive camera was used. In the NIR spectrum most colours appear bright, and this helps the vision system to distinguish between background and box.

The same application is now planned for an automated cereal packaging line in Australia. The basic principle will be the same, but the boxes will be presented in a different way. To enhance the contrast, backlighting will be used and the boxes will pass on two slim belts that only obscure a small part of the picture. The distortions of the box and the geometry of the ends will reveal if the ends have been closed and locked correctly.

**Sugar Bag Completeness**

Sugar bags containing 2 Kg are filled at a rate of two bags a second. The bags pass on a conveyor with a distance of half the width of a sugar bag. This is sufficient to get a good view of all sides.

The packaging machine is very reliable and the defects are less than one in a thousand. However, if a bag is leaking it creates a mess. Another intriguing problem is that a pile of sugar bags on a pallet can collapse if the bags are not sealed properly. The mechanism is not obvious. If a bag at the corner leaks sugar the bag empties and will eventually break under the pressure from the bags above. Then the next bag will be under a high stress and this may also start leaking. Thereby the fault spreads through the pile and in the end the whole pallet can come falling down from a considerable height in the modern elevated storage racks.

This had happened, and it was the main reason why it was necessary to look at every sugar bag coming out of the packaging machine. This of course was a highly demanding operator job, that needed automation with a vision system.

The general rule was to follow the bottom and top geometry. The sides should be
Every sugar bag coming out of the packaging machine needs to be inspected.

straight and square. If the packaging machine failed there would be pieces of paper sticking out at the base or at the top, or the bag would not be symmetrical.

The system statistics showed that the packaging machine performance degraded under certain conditions. A little investigation showed that the humidity in the environment was an important factor. The statistics functions in the vision system again were very useful for optimizing production.

Surprises for QA

Some years ago we delivered an inspection system to a factory producing containers for pharmaceutical products. The production was made to strict quality demands, and all the defects were described in detail. It was our job as system suppliers to provide a system that could find all defects. The production had relied on statistical checking, and if there were problems, to check all containers. The reject rate in the production was about 3%.

When the vision system was installed and operated to the QA rules, 10% of the production was scrapped.

What do you do about that? In a strictly QA controlled environment you cannot just decrease the sensitivity of the vision system and accept another quality standard. If you keep rejecting 10% you cannot supply your custom-