

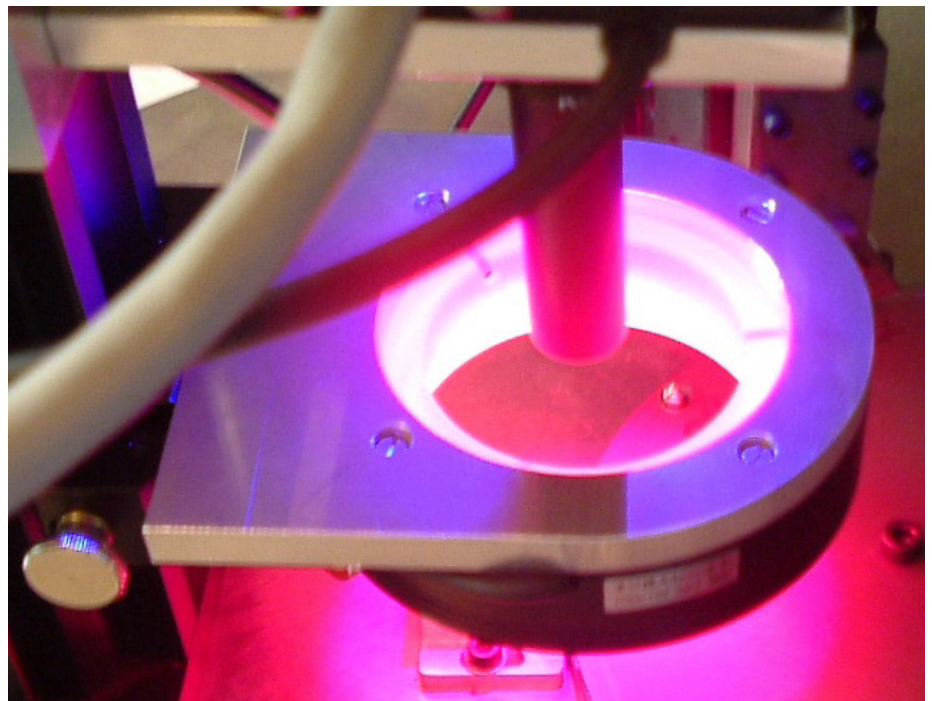
Case study

Automated Examination of Polished Surfaces using Machine Vision

When highly polished parts are inspected by a quality control engineer all he sees is one homogeneous surface without large variations in surface quality. However, with high magnification one can discover frequent scratches, dents, and other surface defects. The following article describes the solution for the recognition of relevant surface textures and defects by an expandable industrial image processing system in conjunction with an innovative lighting concept – so providing a robust automated inspection system for small metallic automotive filter parts.

The automated inspection of surfaces is an important quality control measure, primarily due to the speed of the production which gives no scope for manual inspection of the products without huge labour costs. The errors found on the surface of the metallic filters are made up of two categories, one is the “Cosmetic Defect” which has no real effect on the overall function of the product but looks bad to the eye, the other is a “Functional Defect” which is significant – this error leads to the wearing of the part in a non uniform way due to the way it contacts another sub-assembly surface.

The solution was realised using the latest generation IVS digital cameras in conjunction with the innovative IVS software. The parts are produced by a large supplier to the automotive industry.

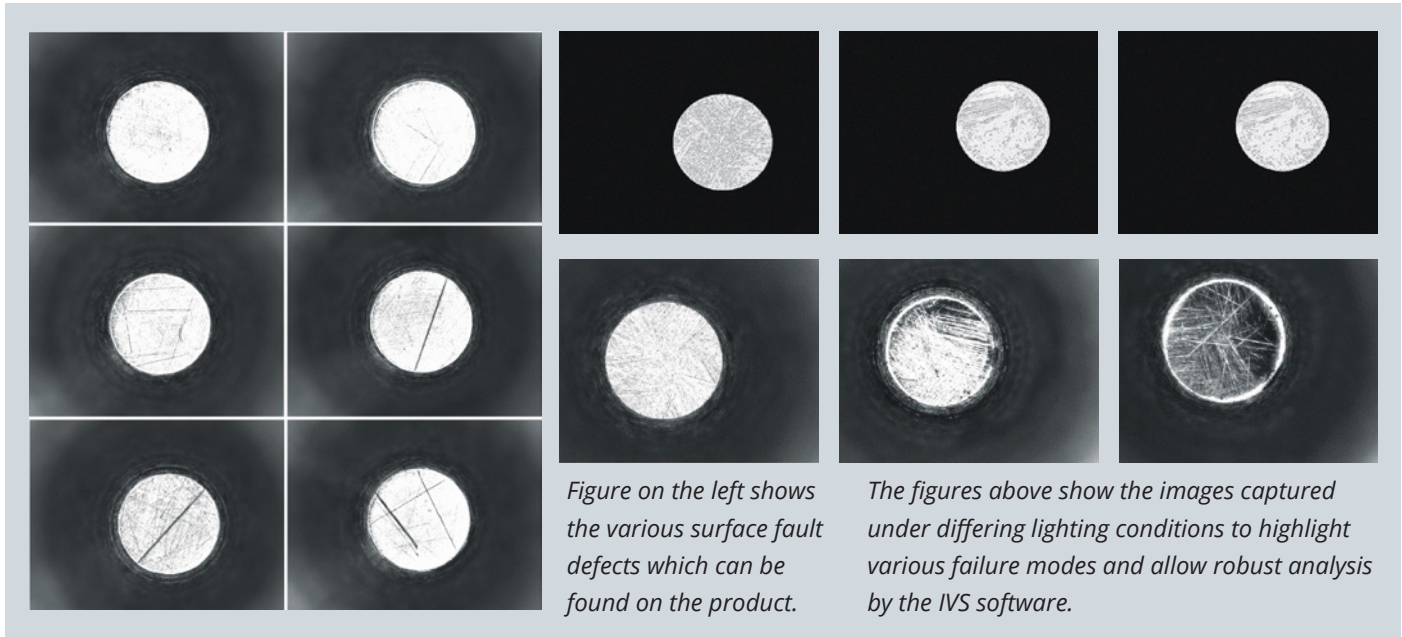


The filters are manufactured at high speed and the automated inspection takes place after a sharpening process is completed on the parts. After this process the components are automatically fed into the in-feed conveyor of the inspection system at a rate of 40 parts per min. The inspection process is divided into two main areas, one is the recognition of scratches and sharpening errors; and the other is the examination of the outer diameter of the product for breaks in the surface as well as checking for dents/inclusions.

The system utilises a 1024 x 768 pixel IVS digital camera over a field of view of 4mm x 3mm square. A Rodenstock macro lens unit was also used in conjunction with a custom designed LED ring lighting

unit. The control system was IVS Professional Software with digital I/O communication to the PLC. All components were built into a mechanical handling unit as part of the overall machine provided to the customer.

A feasibility study was undertaken prior to the final installation of the vision system based on sample parts and a specification provided by the customer. Tests were run utilising varying lighting and image processing techniques to provide a final hardware and software specification prior to production of the final system. Comparative measurements and surface defects were analysed over a large sample group.



The test program is divided into individual inspection tasks within the IVS machine vision software architecture. The test structure is arranged within a graphical interface into a series of sequential check routines. The development of the inspection routines is completed within the same package that runs on the shop floor, thus offering significant flexibility for future changes and additions to the routines as and when required.

The LED lighting system was uniquely designed for the application with two separate lighting units used at set angles to give definition of the surface errors. The LED lights are turned on at the point of inspection, and then turned off again – this mode of operation increases the life expectancy of the lighting units used and enables the lights to be activated at a higher intensity, thus reducing the effect of the ambient light influence on the scene. The relevant surface structures are looked at with a combination of filters

and lighting techniques developed by IVS for finite surface inspection.

The characterisation of the surface is completed by evaluating the contrast, surface structure, axial lengths and formation of the debris and scratches found on the surface. A series of feature screening is completed to give a full analysis of the surface. The surprising element in the set-up of the system was the large variation in surface contrast, with the background tone of the product ranging from 22 to 255 grey levels – this was produced by tooling elements in the previous steps whilst manufacturing the product.

A unique screening concept was created to dynamically change the settings of the automated inspection based on the background level of the product, something which in previous generations of vision systems would just not have been possible. The camera settings of the IVS digital cameras can be changed

dynamically, in real-time, based on feedback from the inspection criteria.

One additional requirement from the customer was to clearly document the test program structure. By utilising the “one-click” documentation facility through IVS the complete inspection criteria could be printed out and logged in XML format. This interactive production of documentation is critical for those companies in the medical devices and pharmaceutical industries.

The application shows how important it is for information exchange and knowledge of customer products to produce complex machine vision solutions. By using the high level of expertise available from Industrial Vision Systems Ltd the customer received a system which operates 100% of the time, showing them the advantage of using a vision partner who has many years of experience in lighting and machine vision solutions.