



# Spring S.r.l. uses laser scanner for quality control of additively manufactured products

## Nikon Metrology 3D scanner adapts laser intensity to suit reflectivity and colour

In early 2014, Italian rapid prototyping and additive manufacturing bureau, Spring srl ([www.springitalia.com](http://www.springitalia.com)), based in Monteviale, near Venice, decided to reverse-engineer components in-house instead of subcontracting the work. After a thorough market analysis, the company bought a 7-axis articulated measuring arm and a digital laser scanning head from Nikon Metrology. The equipment not only allows Spring's customers' parts to be digitised quickly and accurately for reverse-engineering and 3D printing, but also greatly enhances the capabilities of the bureau's quality control department.

Large as well as small parts can be measured using the portable MCAx arm, which carries a ModelMaker 3D laser scanner. Sourcing both elements from Nikon Metrology ensures perfect compatibility and means that Spring can rely on a single supplier for advice and service, the exclusive Italian reseller, Leonardo 3D Metrology, Turin. The supplier's input was invaluable in the early days for providing applications expertise, as the technology was new to Spring.

Roberto Toniello, the company's co-founder and head of the Engineering Department, said, "The Nikon equipment allows us to meet even more efficiently the needs and demands of our customers, so we can offer a more integrated, comprehensive, accurate service in shorter lead-times and ensure maximum reliability of results."

### Reverse-engineering as the input for additive manufacturing

If a product needs to be reproduced but the CAD model does not exist or the original part has been modified, it is necessary to reverse-engineer an actual component. Processing of scan data is carried out by Spring's technical office using Geomagic Studio, which imports the raw point cloud data acquired using Nikon Metrology's Focus Handheld software. The point cloud data is reverse-engineered into accurate surface, polygon and native CAD models. These are exported to one of Spring's 10 CAD seats of Pro Engineer and Unigraphics NX,



*The Nikon equipment allows us to meet even more efficiently the needs and demands of our customers, so we can offer a more integrated, comprehensive, accurate service in shorter lead-times and ensure maximum reliability of results."*

*Roberto Toniello, the company's co-founder and head of the Engineering Department*



*Spring srl uses FDM 3D printing technology to produce end-use armrests in a number of aircraft. It enables the company to reduce its turnaround time by 66 per cent and costs by 50 per cent compared with traditional methods such as CNC machining.*

where STL files are generated for driving six Stratasys Fortus FDM (fused deposition modelling) additive manufacturing machines on site. Two are large 3D printers with build volumes of 900 x 600 x 900 mm, making Spring one of the few Italian companies that can produce objects of that size by FDM.

The machines produce components from thermoplastic materials, layer by layer. They range from standard ABS through weather-resistant ASA to Ultem 9085, a flame retardant material with high strength-to-weight ratio certified for aerospace use. It is also ideal for marine, Formula One and other motorsport applications.

### **Enhanced quality control of printed parts**

Once parts have been built, they are inspected using the scanning equipment to determine their accuracy, using either the laser head or an interchangeable touch probe, or both in a mixed measuring routine. Software from Nikon Metrology provides the measurement and analysis environment, with intuitive tools for both laser and tactile scanning applications. The scanner is in fact used for two-thirds of the time as a metrology tool.

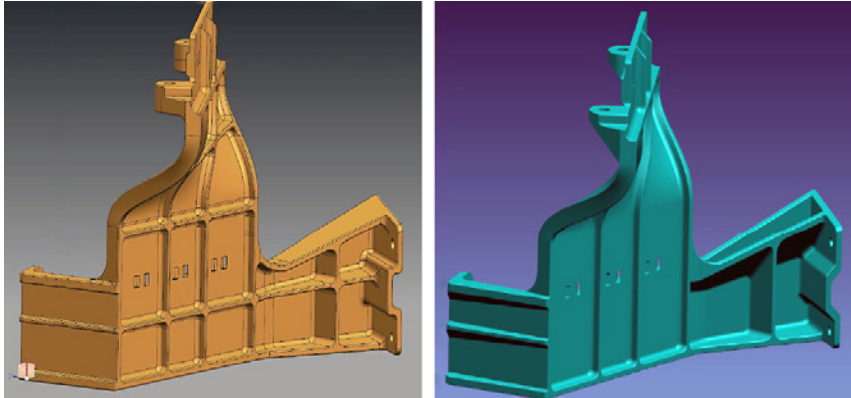
The quality control data collected is analytically compared on-screen to the original CAD file, whether supplied by the customer or derived from reverse-engineering. Any out-of-tolerance features

are observable and measurable. Part-to-part comparisons can be similarly made to determine the reproducibility of a production process. Nikon Metrology's Focus software underpins these activities, managing the acquired point clouds, performing the comparisons, carrying out advanced feature inspection and producing reports.

It is essential for Spring to control component quality closely in this way to verify the accuracy of parts and to generate corroborative reports for its discerning customers. Aerospace and F1 in particular require full traceability of production back to the raw materials, but it was difficult for Spring to provide that level of service before its in-house metrology had been enhanced. A particular area of growth is the provision of 3D-printed thermoplastic cores that are soluble, which are used by its aerospace and motorsport customers for producing laminated composite structures.

### **Early appreciation of the importance of additive manufacturing**

Spring was established in 1998 by Fabio Gualdo and Roberto Toniello to combine their mould and component design expertise with the emerging additive manufacturing technology. They were among the first to recognise that it would allow mass customisation of products tailored to customers' wishes, as an alternative to mass production.



*A cable guide for an aircraft modified and printed in Ultem 9085 by Spring srl using FDM technology (right), and the original aluminium version (left). The weight was reduced by 60 per cent, while both cost and time were saved. The Nikon Metrology scanner was used to assist in the redesign and to control the manufacture of the part.*

Today, the research, design and development bureau serves both ends of the market, manufacturing prototypes and batches of components by 3D-printing, while also designing and supplying moulds for plastic injection and die casting for longer production runs. Italian customers account for 80 per cent of the company's business, the remainder being spread across other European countries.

Fabio Gualdo, Spring's co-founder commented, "In series additive manufacturing, it is often necessary to optimise the design of a component. A piece originally intended to be made by chip removal frequently has to be completely remodelled, especially if it is in a new material, to provide it with the required mechanical characteristics or to reduce weight.

"A good example is our recent manufacture of a helicopter part in Ultem 9085 thermoplastic, instead of the previously used aerospace grade aluminium. Traditional manufacture required a lead-time of four to six weeks and cost around €500 per piece. This has been halved by 3D printing and the time scale has also been cut by one-third."

### **The need for a metrology upgrade**

Mr Gualdo explained that for the past few years, he and his colleagues had felt the need to offer customers the ability to produce parts of more complex shape. However, the firm's manual measuring methods using traditional metrology equipment had significant limitations, hence the deployment of the Nikon Metrology digital scanning arm.

He stated, "Of all the suppliers we reviewed, Nikon Metrology offered the best product in terms of technical specification and service. The MCAX arm, unlike a coordinate measuring machine, is convenient to transport and allows us to examine all sizes of component we produce, up to the very largest.

"The ModelMaker laser scanner has the versatility to inspect all of the thermoplastic parts we print in-house, as well as components we buy in made from different materials. Other scanning systems we investigated were not able to process all of these materials, which is why we decided in favour of Nikon Metrology as a supplier."

### **High quality data from all surfaces**

The cost-effective yet powerful ModelMaker MMCx laser scanner, as with higher-end Nikon Metrology heads, features adaptation of the laser source intensity, allowing any surface to be scanned without the need for spraying or other pretreatment. The unit features enhanced sensor performance (ESP3) that avoids the operator having to manually tune parameters when scanning different surfaces, even those with varying colour, high reflectivity and transitions.

The digital camera has a fast scan rate and offers a measuring accuracy down to 24 microns, more than adequate for inspecting parts on the Monteviale site, which have drawing tolerances typically down to 0.2 mm. Moreover, the scanner has true non-interpolated resolution, allowing freeform surfaces and features to be scanned accurately and efficiently. Laser stripe width is 160 mm and density is 800 points over the stripe width.



*Spring srl is based in Monteviale in the North East of Italy.*

The lightweight yet robust design of ModelMaker allows trouble-free use in production environments and the scanner's Ethernet connection enables easy connection to a laptop. The MCAX arm on which the head is mounted is also lightweight, as it is of carbon fibre tubular construction that is also counterbalanced and thermally stable. Infinite rotation of all principal axes makes for effortless operation and absolute encoders eliminate referencing and warm-up time.

### **Faster turnaround of customer orders**

Roberto Toniello concluded, "The laser scanning arm has made a big difference to our business. Previously we would 3D-print a customer's parts and outsource them for dimensional inspection. It took two to three days for the components and reports to be returned.

Now we can easily use the Nikon Metrology scanning arm to check parts the same day as they come out of the FDM machine, which saves a lot of time and obviously a lot of money as well.

It enables us to quote more competitive prices and also to turn around orders faster, so our customers win twice over.

Similarly, we save time and money in other areas, inspecting tools, jigs and fixtures, for example, as well as plastic injection and die casting moulds."

