

A Joint Effort to Build the Joint Strike Fighter

Creating a 5th generation integrated air system is a complex endeavor. The requirements for the Joint Strike Fighter are numerous—it must be lethal, stand up to the rigors of combat, and be supportable in austere environments. The F-35 JSF must meet diverse needs of multiple services and still be affordable. One of the ways Lockheed Martin has done this is to use Nikon's laser radar and the *SpatialAnalyzer* software.

In October 2001, the U.S. Department of Defense named Lockheed Martin to lead the Joint Strike Fighter (JSF) team as the winner of the contract to develop the F-35 JSF until 2030. Partners in the F-35's System Design and Development (SDD) phase include nine nations. Final assembly of the F-35 will take place at Lockheed Martin Aeronautics in Fort Worth, Texas, with parts from California and England. This joint effort makes the need for precision metrology extremely important. The parts are built at different locations so the measurements must be exact, so the parts fit together seamlessly.

Since securing the F-35 contract, Lockheed Martin undertook immense efforts to identify and vet potential aircraft design, manufacturing, inspection,



F-35 Joint Strike Fighter

and assembly options. While the end product continues to evolve successfully, it's important to assure that products at all levels meet or exceed design parameters. Some concerns still exist regarding how to make rate both at final assembly and at the

major component level. This concern extends to the ease of use, repeatability and speed with which part conformance can be verified and reported. As part of

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Across the Great Wall *SpatialAnalyzer* goes to China

In the past, manufacturers in Europe and in North America came to China to locate new low-cost supply sources for components. So *SpatialAnalyzer* was used because it was specified by these established companies, and Chinese companies adopted it. But as the demand for locally-made products increased in Asia, the Chinese sought to not just make components but to actually perform final assembly of finished products to satisfy local demand.

Major world class companies established final assembly factories in China. These factories were established using European and American technology like *SpatialAnalyzer*. More recently, the Chinese have made the development of Chinese-designed and built products a top priority. This transition of moving from a low-cost part provider to a major completed product manufacturer is happening in industries such as automotive, aerospace, transportation, and

shipbuilding. All of these industry transitions create huge growth opportunities for *SpatialAnalyzer*. For these reasons, NRK created a version of *SpatialAnalyzer* called SA-CHINA.

SA-CHINA has all the functionality of SA Ultimate such as measurement acquisition and geometric dimensioning and tolerancing, plus the capability to import native CAD files from most any popular CAD package. Enhanced by an aggressive price, the power of SA is easily affordable in the rapidly emerging manufacturing economy in China. The math functions of SA transcend any language barriers, but the user interface of SA-CHINA is fully translated into Chinese.

SA is even used in energy-related tasks for sustainable energy projects such as wind, water, and solar power generation. Chinese shipbuilders, aerospace vendors, high-speed train manufacturers, automotive companies, and satellite construction

companies all depend on SA. Naturally, universities, scientific and research development organizations have come to rely on SA as well.

SA enables local companies to automate and integrate precision portable metrology control into manufacturing processes, thus saving time while ensuring improved product quality. Shop floor production can be quickly compared to the original native CAD design file closing the loop on the design > build > inspect production life cycle.

Currently new manufacturing companies in China are established based on technologies developed and validated in more mature manufacturing economies. As these manufacturing processes are mastered and duplicated, the leading edge technology tools such as *SpatialAnalyzer* will equip local engineers to meet the challenges of the most populous world economy. ■

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Can you see the SA in AirbuS? No – because it’s integral.

Metrology is now part of every industrial project, and embedded metrology is the emerging standard. Embedded metrology has become an essential tool for manufacturing. French-based G²Métric is fully involved in the development and integration of measurement solutions for Metrology Assisted Assembly and does significant work with aerospace manufacturer Airbus.

G²Métric has been using *SpatialAnalyzer* for years, and Nicolas Prost, a technical engineer from G²Métric said SA was chosen due to the many different capabilities it has.

“SA is a very powerful software, I would say that it’s the most versatile on the market right now. Whatever you want to do, you can do it. As a service company, SA works for us because we need to answer many different cases and SA provides us these solutions,” Prost said.

Relying on metrology to guide assembly processes began on the Airbus 380 program but has since spread to other Airbus programs such as the A340, A320 and A400M. But the new Airbus 350 project is significantly different. It is notable that this aircraft is one of the first projects for Airbus where embedded metrology was assumed from the beginning of the project.

The goal of this A350 project is to harmonize the solution so all Airbus facilities in Europe (France, Germany, United Kingdom and Spain) follow the same process and do not deploy uniquely developed software for each new integration process.

“...it’s the most versatile software on the market right now.”

Prost explained that a group of Airbus experts designate the required metrology systems and software to be used on the project, and also all the data management architecture. SA has been approved in the list of software to be embedded within such applications.

He said that every A350 part is followed by its measurement characteristic, meaning that every subassembly is measured and results are stored for the next step. All measurement phases need to be automated for the next step, thus driving the assembly by measurement. Assembly of every part is based on the measured “as built” value, not on the nominal. This allows simulation of the assembly to identify in advance if there will be issue, and then drive the



Airbus A380 Air France

tooling and actuators based on feedback from the measurement system.

G²Métric provides the full solution to perform all tasks in an industrial environment under automation that drives a tool’s movement based on automated instrument measurements. SA is embedded in programs using the software development kit to initiate Measurement Plan automation functions. This SDK helps perform calculations on the surface and defining the proper reference frame. It’s also used during the development to justify all the processes and provide essential understanding of measurement uncertainty. The assembly of large components can be more effectively performed with the assistance of leading edge metrology instruments and *SpatialAnalyzer*, according to Prost.

“We do really think that both of our companies can help each other to grow; NRK as a great software solution provider and G²Métric as a leader in metrology integration in Europe,” said Prost.

G²Métric has been building a partnership with NRK since 2003, first as a user, then a reseller and now as an integrator. ■

New River Kinematics: Up, Up and Away!

NRK’s premier product *SpatialAnalyzer* was developed by PhDs Bob Salerno and Joe Calkins, two years after the start of New River Kinematics. The pair continued to work together and picked up a few employees along the way. Since then, the company has grown substantially.

NRK had their first burst of growth from 2002 to 2005 when the company grew from a couple of dozen customers to the point where SA was being used worldwide. This initial growth leveled off after a couple of years.

Then, NRK decided to increase its distribution channels and with additional product enhancements, the company’s growth surged. The results are that the company’s growth has averaged over 20% year after year over the last four years.

With growth comes the challenge of creating the correct infrastructure, while continuing the individualized support that customers have come to expect from NRK. This support and engineering expertise are key for NRK customers to be able to meet and exceed their business objectives.

“Listening to our customers is how we’ve grown. We know intimately what they deal with day-to-day at their jobs, and with their projects. We are here to help them solve the issues that come up,” Paul Collins, President of NRK, said.

NRK’s growth helps create the infrastructure to support their customers to a greater degree. Recently, NRK doubled the number of application engineers for support. They have also opened a new facility with a 10,000 square foot lab for engineers, customers, and partners to use. The lab includes dozens of instruments and robots that are integrated with SA for ease of use. And, because NRK continues to grow internationally, additional international support has been added as well.

“The NRK goal has always been to continue developing SA, to support our customers, and structure the company so that we can continue our trademark of great software, individual support, and engineering solutions,” Collins said.

NRK’s plan for the future is continued growth... but the same customer experience. ■



**New River Kinematics Headquarters
Williamsburg, Virginia**



Power Up: 3Space Multiplies Precision with SA

Mike Gunn, president of 3Space, runs a specialty measurement company that works with several industries, including power generation. He uses *SpatialAnalyzer* for two reasons: confidence and consistency.

“It’s confidence that we have the correct data, that we’ve made all of our quality checks, and when we hand that data over to the customer, we know it’s correct. Consistency across all of our measurement platforms is another key,” Gunn said.

During scheduled outages, 3Space checks critical components of the turbine generators for worn out, damaged, or misaligned parts. Parts are disassembled and replaced as needed – and all of it needs to be put back in proper alignment.

“The lifecycle of a power plant system is

dependent on proper alignment and fit. Anything that’s out of position on a turbine unit takes time off their useful life and causes need for more maintenance in shorter intervals,” Gunn explains.

That’s where *SpatialAnalyzer* comes in – the precision measurements are key for maintenance and for minimizing the outages. NRK Southeast Region Manager, David O’Neal, sees the benefit of a common software platform for power industry giants like Duke Energy. “This allows power gen companies to use all types of metrology equipment including API Trackers, Leica Total stations, and the Faro Focus 3D Scanner in one software environment,” O’Neal said.

Gunn explains why precision is critical for power projects: “The consequences of components not fitting correctly the first time are all bad, but mostly the cost

to the power company is phenomenal for them to buy power from other utilities while they are in an outage. Many of the components we work on contain exotic alloys of metal and take many months to fabricate, so the old adage of ‘measure twice – cut once’ is very appropriate here. It simply has to be right,” he said.

Outages are usually planned around low power usage periods in the spring and fall when people aren’t using heat or A/C in their homes. The power company rotates which turbines and equipment are undergoing maintenance and finds alternative energy sources to cover the needs of their customers. How long an outage lasts depends on how much work needs to take place and how long it takes to do it. The power company tries to minimize this time because they never know when a heat wave or a cold spell will hit and more power will be needed.

“We have retained clients and had many callbacks because of the results we can provide, and the level of confidence the customer has in the data we give them. This is directly attributable to our use of SA,” Gunn said.

That’s why SA is making a difference for companies like 3Space – more efficiency and less time out of service. It’s win-win for everyone involved. Having confidence and consistency means powerful results. ■



Duke Energy Plant

Futuramic Moves into the Future with *SpatialAnalyzer*

Futuramic Tooling and Engineering Company is a high end tooling provider for the aerospace and automotive industries. They are located in Warren, Michigan and began as a tool supplier for the booming auto industry in the 1950s. They continue to have a reputation for providing exotic tooling with speed and precision.

“SA has given us the edge in the industry to show real time and with complete clarity in reporting that high level of integrity.”

Chris Guiney, the Laser Tracker Department Manager at Futuramic, explained the history of the company and how they made a transition to aerospace.

“When automotive fixture manufacturing began to move out of the United States, the auto tooling industry began to back off. Naturally, due to our high level of accuracy in our fixture manufacturing, meeting the aerospace requirements was not a stretch. With over 50 years experience in manufacturing tight tolerance inspection fixtures, we’ve excelled at conforming to our customer requirements and processing them through design and build,” Guiney said.

In large part, Futuramic relies heavily on their use of laser trackers and *SpatialAnalyzer* to meet aggressive production demand. *SpatialAnalyzer* is used during the tool building process, final inspection of tooling and for advanced analysis and reporting. With the increased need for aerospace tooling in the commercial manufacturing and defense industries, Futuramic had the need to decrease build and inspection times and generate detailed reporting. Also, since SA is already widely accepted as the standard in the aerospace measurement world, Futuramic provides final inspection reporting back to their clients in a format they are familiar with.

“SA has given us the edge in the industry to show real time and with complete clarity in reporting that high level of integrity. It was a logical choice in inspection software, one that holds the same level of professionalism as we do. This software works for both beginners and advanced inspectors. And NRK has a very knowledgeable support staff, who are willing to answer any call,” Guiney said.

SpatialAnalyzer’s advanced functionality has benefited Futuramic in several specific ways: SA can handle numerous CAD formats, which have allowed Futuramic to take advantage of nominal CAD models for building and inspection of tooling. Relationship fitting has allowed Futuramic to fit to nominal CAD precisely

and quickly while maintaining engineering constraints and tolerances.

Measurement Plan (MP) has allowed Futuramic to decrease tool inspection times by automating what was historically a manual process and providing faster analysis and reporting. This functionality has led to faster tool inspections, resulting in quicker sign off on the tools. Reporting is an important part of the process, and *SpatialAnalyzer’s* Dynamic Reporting lets Futuramic generate reports for their internal and external customers. The ability to drag and drop items from the SA Tree makes reporting easy, and when combined with Measurement Plan, reporting can be instantaneous.

SA continues to help Futuramic grow and prepare for any measurement challenges it might encounter in the future. Guiney said that they are excited to possess software like SA that’s prepared for today’s challenges and dedicated to meeting tomorrow’s responsibilities.

“Surprisingly we are still probing the depths of abilities this software has to offer. So far it has performed impeccably each time it has been tasked. I have not found a scenario that SA cannot handle,” Guiney said.

That is great news for the future of Futuramic and all other SA users. ■

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Joint Strike Fighter

their process, Lockheed Martin Aero subcontracted component parts to qualified partner suppliers. This makes rapid deployment of part production and verification to a quickly expanding supplier base critically important.

Lockheed Martin selected the Nikon Laser Radar measurement system for part inspection. The Nikon scanner, like most other portable measurement sensors, can be used for highly precise measurement tasks. Because of the instrument's unique capabilities for quick, high accuracy, target-less measurement, on a wide variety of surface materials, it's an ideal choice for automated inspection routines. The technology is both leading edge and proven—and includes an important advantage: a premium graphical metrology software package called *SpatialAnalyzer*.

SpatialAnalyzer was developed in 1996 by New River Kinematics. Lockheed Martin uses SA with various portable metrology systems. NRK was the first to develop and maintain a complete software interface accessing the full capabilities of the Nikon laser radar system.

Using SA, the Nikon instrument can be guided through complex measurement tasks with predefined SA Measurement Plans. While SA MP's offer tremendous flexibility and a wide range of measurement process control, an operator can also revert to manual instrument control as needed. While the Nikon laser radar and *SpatialAnalyzer* offer the most versatile portable measurement technology available for Lockheed Martin's inspection tasks, the challenge is to make a cutting edge, very flexible measurement system easy to use, repeatable and scalable.

"Nikon Metrology's Laser Radar system, powered by NRK's *SpatialAnalyzer* software, is an essential component to the Cured Laminate Compensation (CLC) process – it increases customer productivity and quality. This is all accomplished with an added benefit of reducing overall manufacturing cost," said Robert Wasilesky, Nikon's senior vice president of sales and marketing.

NRK has successfully delivered unique, simplified user interfaces that enable shop floor personnel with little initial training to quickly perform relatively complex data collection, analysis and reporting activities using such instruments as the Nikon Laser Radar system.

This interface is called Metrology Automation Part Inspection System (MAPIS) and using a combination of proprietary NRK development tools and SA base libraries, a unique users interface (UI) was developed for Lockheed Martin's JSF program. The UI is simple enough that shop floor personnel have successfully used it, yet it is robust enough to accommodate Lockheed Martin's needs for proper and thorough inspection.

Lockheed Martin and the Joint Strike Fighter gain many benefits from the innovations of Nikon and *SpatialAnalyzer* including: repeatable accurate processes, less uncertainty and consistent results. Those benefits aren't stealth, they're measurable! ■

SA: Making the Grade at Janicki

Janicki Industries designs and builds high-precision tooling for aerospace, marine, wind energy and transportation customers. Some of its aerospace customers include Boeing, Lockheed, ATK and NASA. To serve the challenging needs of these

SpatialAnalyzer is a traceable metrology 3D graphical software platform that can simultaneously communicate to virtually any number and type of portable dimensional measurement systems. It also simplifies complex analysis tasks.



Janicki Industries

industries, Janicki integrated portable metrology technology into its daily manufacturing processes several years ago.

As technology in this area advanced, so have customer demands for tighter tolerances and supporting quality documentation. The requirements of current and new customers for more sophisticated components and production rates continue to drive Janicki to seek new ways to leverage its investment in the area of metrology. Janicki responded to these demands with significant investments in both hardware and software.

Today, Janicki has a world class array of portable metrology instruments that includes laser trackers, laser radar, CMMs and various other devices. But it's important to note that these instruments are only as good as the software that controls them.

In 2010, there were two primary software solutions in use at Janicki, and *SpatialAnalyzer* (SA) from New River Kinematics was one of them. For years, Janicki used a combination of metrology solutions. However, to meet the ever-increasing and stringent requirements mandated by its customers, Janicki found itself routinely turning to SA as the portable metrology solution of choice.

Standardization was the next logical step to improve their metrology program. After a thorough evaluation, Janicki selected SA as its standard solution for portable metrology applications at all of their facilities.

As a result of their standardization program, Janicki will see measurable gains in productivity and reductions in operational cost. Improvement areas include: reduced training cost, work cell automation with SA measurement plans, improved communications and reporting. That's why SA has emerged as the software of choice at Janicki and also at many of its large aerospace customers.

The SA Advantage

- NRK's founders and lead developers are Mechanical Engineer PhDs – that means SA was designed from day 1 as a Metrology Engineering Solution
- Optimization capabilities assure quality production and reduce cost
- SA's unique USMN function provides answers to measurement uncertainty issues in an easy-to-use environment. It's a tool that provides detailed information that is indispensable in achieving customer quality requirements and enhancing communications
- 100% traceability for total quality assurance
- Full automation of measurement and analysis tasks improves productivity

Automation, is a significant new opportunity for Janicki. SA's Measurement Plan functionality provides the ability to automate many tasks associated with capture of measurement data, model comparisons, subsequent analysis and reporting. MP is a configurable and programmable platform that is easy-to-use, yet delivers solid reliable solutions for engineers and production work cells. It reduces errors, saves time and can be integrated into production processes. Customers using SA and well-crafted MP's routinely realize significant savings. Just ask Janicki! ■

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