X-ray computed tomography (CT) has successfully entered the field of coordinate metrology as an innovative and flexible non-contact measurement technology for performing dimensional measurements on industrial parts. It provides advantages not available with conventional tactile and optical coordinate measuring machines (CMMs), giving the ability to perform non-destructive measurement tasks that are often not possible with any other measurement technology. These include, for example, the inspection, without any need to cut or destroy the components, of complex, high-value additive manufacturing products featuring a high density of information.

In the aerospace market, CT can be used to inspect smaller to medium-sized components such as turbine blades, aluminum castings and tube welds. With CT, quantitative analyses can be performed at several stages of the product cycles, enabling the optimization of products and manufacturing processes and the evaluation of conformity to product specifications.

The three main components of an x-ray CT system are the x-ray source, rotary table and detector. Different CT system configurations exist: for example, flat panel detectors (also known as digital detector arrays [DDA]) or linear diode array detectors (LDA) can be used. With LDAs, the phenomenon of x-ray scattering, relevant while scanning high-density materials such as in aerospace applications, does not impact the scan. Longer scanning times are required, however. The x-ray source to detector distance and x-ray source to object distance define the geometrical magnification of the CT scan and the voxel size of the 3D CT model of the part. The use of variable x-ray source to detector distances, as offered in the NSI system portfolio, is also fundamental for aerospace applications to achieve the best signal possible. Indeed, being the CT technology based on x-ray attenuation principles, the size and the thickness of the part and the material density play fundamental roles. The bigger the component and the denser the material, the more power is required for the x-rays to penetrate.

The output of a CT scan is the 3D model of the part. This model is used to perform accurate measurements of the entire workpiece without any form of contact or need to cut or destroy the part. CT also enables material inspection and identification of internal defects such as voids and cracks and can be used to identify delaminations when inspecting composite materials.

In Figure 2 the color bar represents the different pore sizes, which are also visible on the 3D CT model. The size of the porosities or defects that can be detected depends on the scan resolution, which is also a function of the part size, geometry and material. Advanced scanning techniques such as NSI Subpix can achieve an improved resolution and therefore a larger field-of-view for a given resolution.

Other CT applications include nominal/actual comparisons in which the volumetric model of the actual part is registered and compared to its nominal model and fiber analysis for composite materials.

CT offers a wide range of advantages over conventional measurement technologies, including the ability to perform holistic measurements of the component on complex and/or non-accessible features in a non-contact and non-destructive way, with high density of information. In aerospace this is fundamental because the often high cost of parts does not encourage destructive testing. CT also enables engineers to quickly evaluate the conformance of the parts before high-cost machining processes. When measuring, for example, the freeform surfaces of turbine blades, CT can provide a high density of points in a much shorter time than conventional tactile CMMs, and being a non-contact technique, there is no need for probe tip compensation when inspecting freeform surfaces.

The testing and inspection of high value and complex components can be achieved faster and more cost-effectively with x-ray CT scanning providing information on the different porosities’ volumes. The size of the porosities or defects that can be detected depends on the scan resolution, which is also a function of the part size, geometry and material. Advanced scanning techniques such as NSI Subpix can achieve an improved resolution and therefore a larger field-of-view for a given resolution.

In Figure 2 the color bar represents the different pore sizes, which are also visible on the 3D CT model. The size of the porosities or defects that can be detected depends on the scan resolution, which is also a function of the part size, geometry and material. Advanced scanning techniques such as NSI Subpix can achieve an improved resolution and therefore a larger field-of-view for a given resolution.

Other CT applications include nominal/actual comparisons in which the volumetric model of the actual part is registered and compared to its nominal model and fiber analysis for composite materials.

CT offers a wide range of advantages over conventional measurement technologies, including the ability to perform holistic measurements of the component on complex and/or non-accessible features in a non-contact and non-destructive way, with high density of information. In aerospace this is fundamental because the often high cost of parts does not encourage destructive testing. CT also enables engineers to quickly evaluate the conformance of the parts before high-cost machining processes. When measuring, for example, the freeform surfaces of turbine blades, CT can provide a high density of points in a much shorter time than conventional tactile CMMs, and being a non-contact technique, there is no need for probe tip compensation when inspecting freeform surfaces.

In Figure 2 the color bar represents the different pore sizes, which are also visible on the 3D CT model. The size of the porosities or defects that can be detected depends on the scan resolution, which is also a function of the part size, geometry and material. Advanced scanning techniques such as NSI Subpix can achieve an improved resolution and therefore a larger field-of-view for a given resolution.

Other CT applications include nominal/actual comparisons in which the volumetric model of the actual part is registered and compared to its nominal model and fiber analysis for composite materials.

CT offers a wide range of advantages over conventional measurement technologies, including the ability to perform holistic measurements of the component on complex and/or non-accessible features in a non-contact and non-destructive way, with high density of information. In aerospace this is fundamental because the often high cost of parts does not encourage destructive testing. CT also enables engineers to quickly evaluate the conformance of the parts before high-cost machining processes. When measuring, for example, the freeform surfaces of turbine blades, CT can provide a high density of points in a much shorter time than conventional tactile CMMs, and being a non-contact technique, there is no need for probe tip compensation when inspecting freeform surfaces.
Measure Beyond the Surface

We build world class metrology focused industrial digital X-ray and 3D computed tomography systems, offer X-ray inspection contract services, and train your experts so you can develop the world’s best products.

4nsi.com/ati | +1 (866) 754-4902 | sales@4nsi.com