Application Example:

Scanning down to the smallest Detail – Optical Metrology supports the Building of full-scale Helicopter Mock-ups

Measuring system: ATOS Triple Scan
Keywords: aerospace, reverse engineering, CAD data, quality control, inspection, optical 3D metrology, coordinate measurement, touch probe, positioning and alignment

To support the training of maintenance crews for military helicopters under real-world conditions, Reiser Systemtechnik GmbH uses optical 3D metrology when building full-scale helicopter training rigs. With the ATOS 3D digitizer from GOM, all components and ancillary equipment of the original NATO NH90 transport helicopters are scanned and archived. This scanned data enables Reiser Systemtechnik to quickly build full-scale mock-ups that are used as maintenance training rigs. This approach saves not only time and money, but also ensures a high level of precision. This is very important because the helicopter mock-ups are subjected to careful quality control inspections using optical metrology during and after assembly.

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To keep military helicopters deployed for as long as possible, all required maintenance services need to be carried out quickly and reliably. This requires specialized hands-on training for maintenance crews at regular intervals – ideally using the actual helicopters. However, this is usually a problem. NATO NH90 transport helicopters are usually out on assignments so that they are virtually never available for maintenance training. In order to keep the training program updated and on track, the German and French armed forces turned to Reiser Systemtechnik GmbH in Berg-Höhenrain, Germany. The company in Upper Bavaria is well-known for its expertise in building training mock-ups that replicate complex military systems. The armed forces ordered five helicopter mock-ups, also known as rigs, for the training program: four army versions and one navy version. (Fig. 1)

Fig. 1: The NATO NH90 transport helicopters are almost constantly in service – and so are seldom available to maintenance crews for training purposes. Thus full-scale training rigs are built to fill this gap.

The rigs are full-size scale models of the actual helicopters. They are made of fiber composites and aluminum, and are fitted with ancillary equipment of relevance to training. Crews can practice maintenance procedures, including component and system replacements, as if they were working on the helicopters themselves. All of the maintenance jobs are performed in strict accordance with the military maintenance manuals, which means that the training rigs must be exact replicas of the helicopters – right down to the smallest details. The training enables crews to carry out maintenance much faster, and it reduces the number of mistakes that could arise when ancillary equipment is replaced. "We offer our customers the advantage of availability, because unlike the helicopters, the training rigs cannot be deployed for flight missions. What's more, using the training rigs is a lower-cost alternative to using the original NH90 helicopters," says Dr. Martin Wilke, Department Head of Projects and Systems Engineering.

The first step of the project involved a study to determine the precise training requirements for the rigs. The requirements profile of the NH90 rig was comprised of more than 1200 maintenance tasks. These included the removal, repair and installation of components essential to operating the aircraft.

In building the helicopter training rig, the ATOS Triple Scan 3D digitizer from GOM is used for non-contact scanning of all components, surfaces and ancillary equipment of the original helicopter – from the smallest screws to the largest airframe components, including both aluminum and fiber composite elements of all sizes. The three-dimensional scan data is then imported as an STL mesh to CAD systems for reconstruction (Reverse Engineering). Simulations are also carried out on the basis of FEM computations. (Fig. 2)

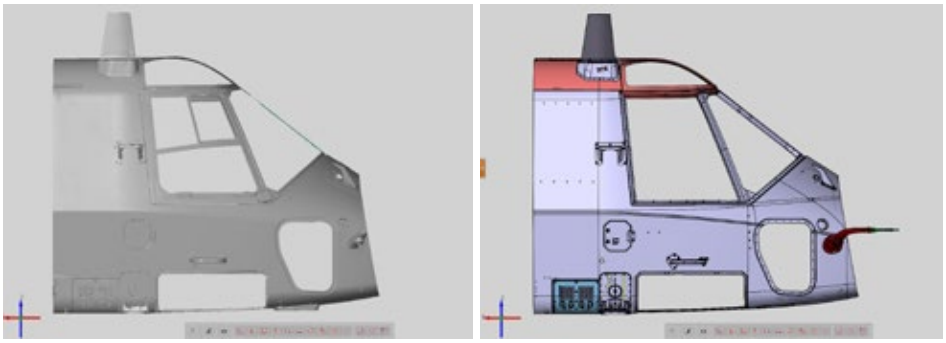

Fig. 2: The three-dimensional scan data (left) is imported as an STL mesh to CAD systems for reconstruction (right). Simulations are also carried out on the basis of FEM computations.
(Photo: Reiser Systemtechnik)

During final assembly another 3D scan is conducted to guarantee the correct positioning of specific parts in relation to each other, and to inspect individual components under load. Again, this process is carried out with ATOS Triple Scan from GOM. "When checking the position of the helicopter airframe on the assembling jig, as well as the positioning of the exterior shell panels on the airframe itself, ATOS Triple Scan – with a measuring volume of 2000 mm and the GOM touch probe – delivered outstanding results," explains Sylvain Rid, Project Manager for the NH90 maintenance training rig. "We have drastically reduced the time needed for assembly, and given a major boost to precision." (Fig. 3)

Fig. 3: During final assembly of the training rigs, more 3D measurements are carried out with ATOS Triple Scan. The correct positioning of the individual components is also verified point-to-point using an optically tracked touch probe.

(Photo: Reiser Systemtechnik)

The ATOS Triple Scan 3D digitizer has two cameras with a resolution of up to 12 megapixels. Compared with conventional tactile coordinate measuring devices, which only measure individual points, optical 3D systems such as ATOS measure the entire surface of a particular component. This is based on the triangulation principle. The ATOS system projects fringe patterns on the component under inspection – these patterns are then recorded by two cameras. Thus millions of points with fine details can be measured in a non-contact process lasting only a few seconds. The ATOS software then automatically calculates the 3D coordinates in the form of a high-resolution point cloud (STL mesh). The ATOS 3D digitizers operate with Blue Light Technology. The projection unit's narrowband blue light supports precise measurements under any environmental lighting conditions – and even of shiny surfaces.

ATOS Triple Scan has a 3-in-1 sensor system. The right and left cameras each function individually in relation to the projector. This combination results in three sensors, each having a different perspective on the inspected component, so that three views are captured during one scan instead of just one. The measurements take less time thanks to a major reduction in the number of individual scans, even for complex parts. Scanning in deep slots is an added bonus of this concept. Areas of application for the 3D digitizer include quality control, reverse engineering, rapid prototyping, CNC machining and digital mock-up.

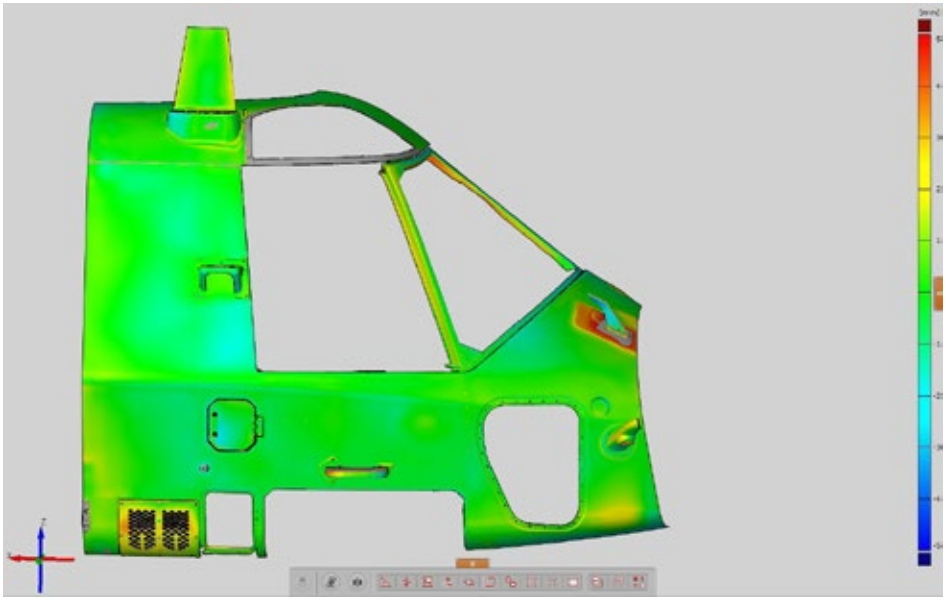

Fig. 4: During final assembly of the training rigs, the outer shell or „skin“ is inspected for possible deformations. The full-surface measurement data is compared with the CAD data set. Deviations from CAD are highlighted in color and easily recognizable as problematic areas, enabling specific improvements to be made to the manufacturing process.

(Photo: Reiser Systemtechnik)

During the procurement process, Reiser considered systems from two other manufacturers, in addition to GOM. “Neither of those products met our requirements in terms of precision and versatility, for both extremely large and extremely small objects,” explains Dr. Martin Wilke. In contrast, the GOM system satisfied every requirement, for example, when it came to point-to-point positioning inspection using the optically tracked touch probe, and for 3D surface scanning to detect possible deformations in the outer skin covering the airframe (Fig. 4). Reiser was demanding a system that would address all of its needs. “The versatility of the ATOS 3D digitizer, making it suitable for use in a wide range of customer projects, was a very important factor in our decision,” says Wilke. What’s more, the system’s mobility and flexibility makes it an ideal choice for scanning on-site for suppliers and customers.

The first training rig has been completed and delivered to the German Air Force Training Academy in Fassberg. Four additional models will follow. Following initial testing, which also covered the NH90 engine, the feedback from the armed forces was very positive – the quality, effectiveness in training and realistic replication of the rig all were convincing. (Fig. 5) The project also met expectations in terms of cost-effectiveness because the training rigs enable significant savings – original training helicopters would be up to 70 percent more expensive. Due to these factors, plans call for applying this new approach to other military and civilian systems that require maintenance training.

Fig. 5: The first training rig has been completed and delivered to the German Air Force Training Academy in Fassberg. Four additional models will follow.

(Photo: Reiser Systemtechnik)

Reiser and NH90
Reiser Systemtechnik GmbH is one of the leading manufacturers of flight simulator, training and avionics test systems. The company was founded in 1988 in Farchach in Upper Bavaria. Initially it was involved in cable assembly and the production of heat exchangers and controllers for laser technology. In 1990 Reiser moved to its current location in Höhenrain, about 25 kilometers south of Munich, and shifted its business focus to the development, production and maintenance of simulators for military aircraft. Today Reiser Systemtechnik GmbH employs more than 200 people in the training and simulation segment. In addition to its core simulation and training business, Reiser Systemtechnik GmbH also offers optical measuring and reverse engineering services with GOM systems.

The NH90 (NATO Helicopter 90) is a medium-sized military transport helicopter in the ten-ton class manufactured by NATO Helicopter Industries. It is designed to serve as the backbone of the helicopter fleets in many NATO member countries and other nations around the world. With 500 confirmed orders worldwide to date, the NH90 represents the largest military helicopter program ever launched in Europe. It is also the first European helicopter to be exclusively equipped with on-board systems that are monitored and controlled digitally. The NH90 is produced in two variants – the TTH (Tactical Transport Helicopter) for land-based and amphibian operations, and the NFH (NATO Frigate Helicopter) for naval missions. The basic differences between the two versions are specific marine modifications that enable the helicopter to operate from small flight decks.

We thank Reiser Systemtechnik for the trust in our measurement technology and the professional realization of this project.