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Major Process Improvements in Aerospace Applications by Integration of Camera Based Measurement Technology

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Major Process Improvements in Aerospace Applications by Integration of Camera Based Measurement Technology

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Abstract:
Photogrammetry is experiencing a small renaissance in a diverse set of aerospace applications such as assembly, quality inspection, and R&D testing. Improvements in camera technology and the availability of automatable process knowledge have led to a wide field of applications where photogrammetry solutions bypass the drawbacks of alternative metrology equipment.

Inspection automation, guided measurement and assembly processes, as well as universal testing tools are only a few examples where significant improvements in process efficiency and data quality have been realized. In this presentation, three novel applications based on optical measurement sensors will be discussed.

Application 1: Metrology-Aided Assembly of main landing gear into landing gear box

The assembly process of the main landing gear (MLG) into the main landing gear box (MLGB) is a dynamic procedure. To avoid damage from a collision with components already installed in the MLGB, the MLG is being tracked during assembly process by a multiple camera system with high accuracy. In this process, it is essential to measure multiple target points simultaneously because serial measurement based on the assumption of a stationary aircraft is invalid. Photogrammetric measurements are used to calculate offsets for the loading path. Then multiple points (photogrammetric adaptor) on the MLG are tracked in real time during loading to hold the MLG on track. Main advantages are: user independent results, applicable to non-static aircraft, simplicity of working principle.

Application 2: Adjustment and final inspection of aircraft doors

Aircraft doors need to be adjusted to nominal lock positions and a large number of inspection points have to be checked before delivery and assembly into the aircraft. The time required for the adjustment and inspection process using 6DOF laser trackers was the production bottleneck for one door manufacturer. In order to reduce cycle time as well as to increase the number of inspection points, a mobile, multi-camera approach was implemented. Adjustment of the several door locks and attachments and final inspection, including probing of relevant surface inspection points are accomplished in half the cycle time. As usual in aerospace production, the full process is integrated in assembly personnel focused software solution.

Application 3: Deformation and load tests on mid-size and large aerospace structures

During the structural testing of aircraft components, forces are induced to a test sample in order to simulate deformation of the structure during take-off, flight, landing or even assembly processes. In some cases, those tests are carried out until breakage of the parts. Measurements during these tests were traditionally performed using string gauges. However, the cumbersome and time-consuming setup as well as the difficulty of integrating the single 1D string gauges into one common 3D reference frame led to the use of camera-based measurement systems.

Aircraft manufacturers and suppliers are now adopting the next generation of this measurement principle to exploit the advantages of multi-camera photogrammetric system. Their testing procedures have been improved significantly by installation of camera tracking systems on a test rig. Due to the upgrade to the new technology they are able to reduce the setup time by a factor of more than 5 while increasing the density of measurement points. As result, 3D coordinates plus deformation vectors are derived for each point with higher accuracy than ever before. Also, larger deformation can be recorded without loss of data. Three examples utilizing optical camera-based measurement will be presented: deformation of the passenger door during cabin pressure change, load tests on helicopter cabins and structural testing on large cylindrical object.