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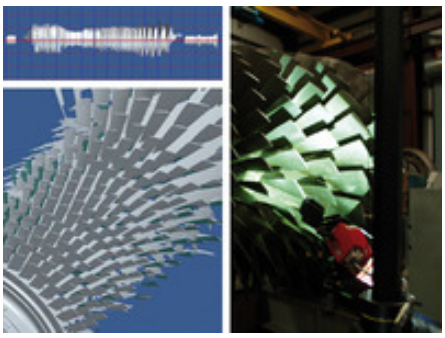
Power Generation Fact Sheet

Optical 3D measurement technology from GOM supports turbine manufacturers and their suppliers throughout the product lifecycle. GOM's systems accelerate development and manufacturing processes, including optimization in research & development, quality assurance in production, dynamic load tests during operation and product life analysis. In addition, optical measurement technology offers major cost-cutting potential for maintenance and repairs on turbine blades, housing elements and structural parts.

Scan-Xpress offers its sales and service experience and support in the gas & steam turbine, hydropower, wind energy and propulsion sectors.

- **Gas- & Steam Turbines**

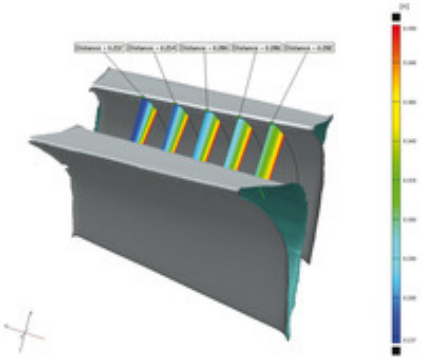
Lifetime Prediction for Gas & Steam Turbines



Checking turbine lifetimes is vital to ensure that components do not fail prematurely. One aspect is the wear on turbine blades, which can be analysed at different stages during operation. This makes precise forecasts of component lifespan possible. In manufacturing environments, contactless measurement systems from GOM are used to control the uniform application of thermal barrier coating onto blades.

- Analysis of Thermal Barrier Coating (TBC)
- Control of Cooling Holes and Pitch Corrosion
- Inspection of Blade Deformation caused by Airflow Creep

CFD & FEA Analysis on Gas & Steam Turbines



Real component geometries are the most suitable for efficiency level analysis and efficiency optimization. Computational Fluid Dynamics analysis (CFD) makes it possible to analyse factors such as turbulence, flow and resistance.

To improve turbine efficiency, systems from GOM measure blade geometry, leading and trailing edges as well as the opening angles between individual blades.

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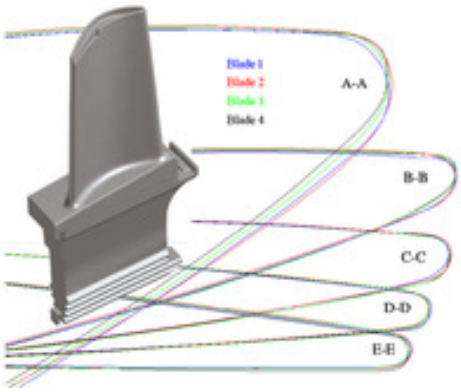
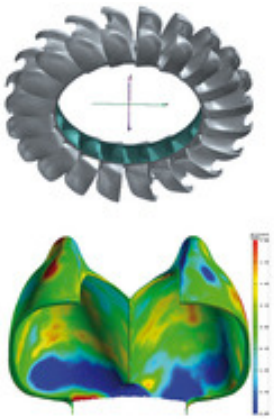
Intelligent software solutions help define the current efficiency ratings based on wear. The finite element method greatly improves geometry and construction in component design. Precise 3D coordinate measuring data for real components supplies a reliable basis for comprehensive simulations of component behaviour and their capacity limits.

Reverse Engineering / Golden Master



CAD data is remastered several times during the design process. All too often, suitable CAD data for an OEM or supplier component is not available. In this case, 3D digitizing using systems from GOM and reverse engineering offer intelligent solutions for reliable documentation. When it comes to making changes to individual components or tools, the CAD data can be swiftly updated and used as a reference for incoming parts inspection. The precise 3D point clouds of ATOS help gas and steam turbine operators create golden masters from third-party or self-manufactured turbine blades based on a comparison of different 3D models.

- **Hydropower**



Optical 3D coordinate measurement technology from GOM is the ideal solution for capturing the complex geometries and free-form surfaces of Pelton wheel, Francis and Kaplan turbines. It is used to analyse blade geometry tolerances as well as the distances and angles between individual blades to ensure that turbines rotate smoothly and with minimum vibration. In addition, reverse engineering and a golden master are ways of greatly improving turbine efficiency. Reliable and robust measurement technology from GOM provides analysis results fast, especially when problems occur with installed turbines.

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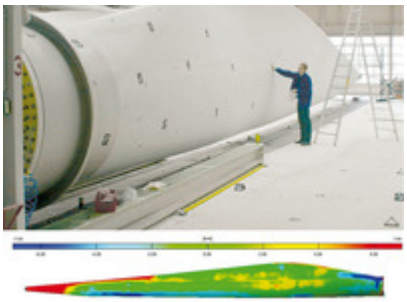
- **Wind Energy**

3D measurement of rotor blades



Having information about the effective surfaces of rotor blades and turbines is vital in order to control and optimize production processes. Optical measurement technology from GOM can be used to verify the shape and dimensions of rotor blades, point wise or across the entire surface, against CAD or master data. The measured data can also be used in reverse engineering to create a copy of an optimal rotor (ATOS 3D Digitizer).

Inspection of mounting surfaces on wind power plant

The individual components of wind power units often only come together just before assembly on-site.

The portable TRITOP^{CMM} measuring system can be used to measure and inspect mounting bolts and surfaces in less than one hour. This is also possible for off-shore foundations and structures. Thus, mounting bolts that are not in the correct position can be identified and adjusted before construction begins. This ensures smooth assembly of wind power plants without the risk of additional costs or delays (TRITOP^{CMM}).

Bending fatigue test for rotor blades

Rotor blades are subject to high stress on account of their weight and the force of irregular winds. They therefore undergo comprehensive bench tests to verify their operational stability and strength. Their behaviour is analysed under normal to shear stress conditions as well as in the bending fatigue test. For precise analysis of strain and deformation on rotor blade surfaces, the mobile and flexible optical measuring systems from GOM can be integrated quickly and easily in rotor blade test stands. This provides valuable information about the behaviour and robustness of rotor blades, including local strain and deformation data. The optical 3D data is also useful in verification of simulation calculation models and enables the continuous optimization of wind power units (ARAMIS 3D Deformation Analysis System).

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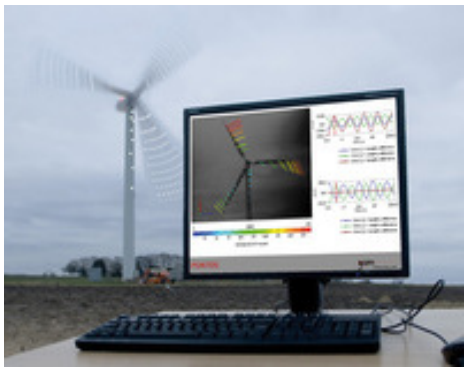
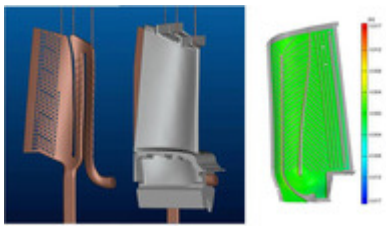
Dynamic deformation analysis of wind power units in running operation



Dynamic online deformation measuring systems from GOM are standard tools for analysing and visualizing deformation on aerodynamically loaded structures. This technology is also used to analyse the entire structure of wind energy plants to enable modal analysis and monitoring of vibration characteristics while units are in operation. Acceleration, deformation (torsion, bending, etc.) and the angular position of the rotor blades are all analysed, along with vibrations in the entire unit and deflection of the tower due to wind forces and emergency braking (PONTOS Dynamic 3D Motion Analysis).

- **Propulsion**

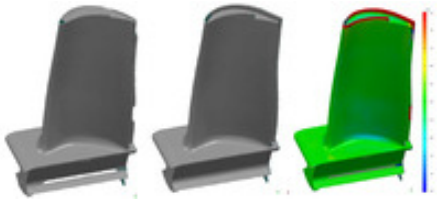
Efficient quality control for turbine blade manufacturing



Manufacturers and suppliers use optical measurement technology to accelerate production start-up time long before first sample testing actually takes place. What's more, GOM systems provide a full range of control functions during the production process.

- Inspection of ceramic cores
- Inspection of wax models
- Analysis of shrinkage and warp
- Optimization of injection moulds/processes
- Control of cooling tunnel systems (EMP)
- Shape and dimension analysis of cast and forged components

Repair & Maintenance



Maintenance and repairs are enormous cost factors throughout the entire product cycle. In addition to wear and tear analyses, GOM optical measurement technology supports the planning and control of repair jobs (ATOS 3D Digitizer).

- Digital coordinate measurement of damaged/prepared surfaces
- Verification of material deposition
- Inspection of repair work

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Housings & Components

GOM systems can be used to measure anything from very small turbine blades up to turbine housings and large aggregates, as well as voluminous components for digital mock-ups.
Air inlet rings and combustion chambers for assembly control are also easily measured (ATOS 3D Digitizer, TRITOP^{CMM}).

Dynamic Deformation Measurement

Dynamic deformation measurement visualizes the behaviour of aerodynamic structures in real use.
During running operations, for example, vibration, acceleration, deformation and imbalance can be analysed (PONTOS Dynamic 3D Analysis).