



VISION BASED ROBOTICS

VISION *B A S E D* ROBOTICS



The System

Despite all the progress in IT and sensor technology, automation of „Lotsize 1 production“ – manufacturing processes with a high number of variants – is still a demanding task.

With *VISION based* robotics, ATENSOR offers a high-performance toolbox for the efficient and affordable automation of industrial manufacturing processes with Lotsize 1 characteristics.

VISION based. The workpieces are precisely measured in three dimensions. Based on the generated surface model, our innovative software package can carry out tasks from object and position detection to the calculation of cycle time compliant robot programs fully automatically.

VISION based robotics impresses by its high flexibility and productive efficiency – a sustainable benefit for your production.

Mix and Match

Build a complete system of high quality from individual components: The configuration matches exactly your requirements and enables setting up your innovation process.

VISION based robotics is precise, individual, affordable, flexible.

VISION based robotics develops with your requirements!

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ATENSOR

acts as the competence center for robotics and robot-based measurement technology within the internationally operating Micro-Epsilon group. The company thus focuses on one of the most disruptive technologies of the future.

Real high tech solutions

Customers such as Daimler, BMW and Honda count on our innovative integrated system solutions for automation and quality assurance and use them successfully in industrial manufacturing processes.

Fields of Application

painting/coating – wet, powder

cleaning using CO₂ pellets, high pressure water

conserving, blasting

sanding/polishing, deburring

assembling, inspecting

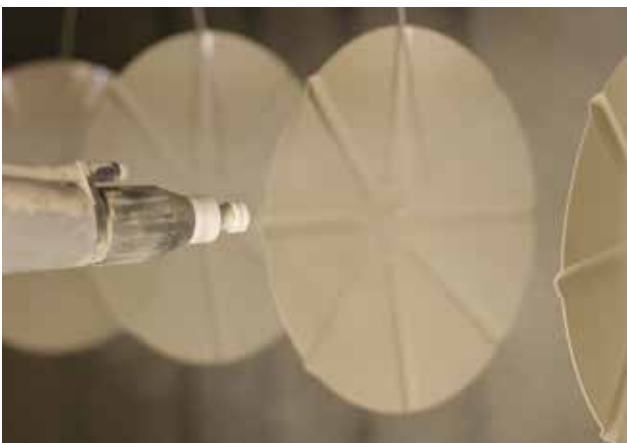
and many more



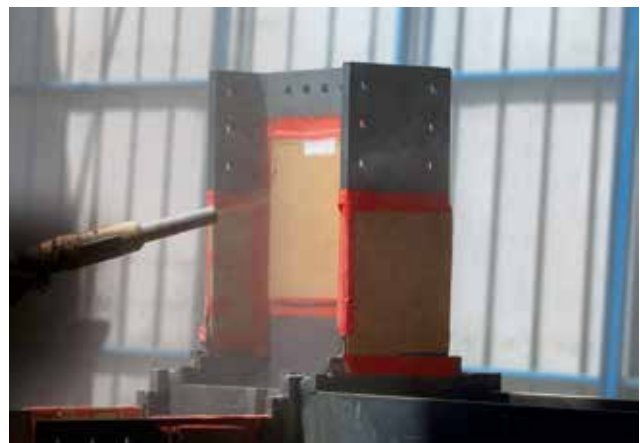
Painting of heavy duty diesel engines, Source: Daimler AG



Cleaning of heavy duty diesel engines using CO₂ pellets, Source: Daimler AG



Fully automatic powder coating



Sandblasting in a manufacturing process

The Process



1 Smart3D Scan

For in-line digitalization, the workpiece is measured using an innovative industrial 3D sensor system consisting of several smart sensors.

Without stopping the workpiece, the flexible arrangement of the 3D sensors provides a complete 3D image of the entire workpiece surface due to the different viewing angles.

2 Automated Path Planning

Based on the 3D scan, fully automatic robot path planning is carried out for the individual processing of each workpiece.

The checks integrated in the automatic path planning guarantee collision and singularity free robot programs.

3 Automated Surface Treatment

The fully automatic generation of robot programs can be utilized in a wide range of processing steps such as cleaning, blasting or painting.

The automated processing guarantees a constant high product quality with reduced production costs.

Components – Overview

Smart3D Sensor System	3D Part Recognition
3D Scene Reconstruction	Robot Program Adaption
6D Localization	Automatic Robot Program Generator
Parametric Matching	Parametric Robot Program Generator

mix and match

The Components

ATENSOR Smart3D Sensor System

Industrial 3D multi sensor system for in-line digitalization in the production process

The **ATENSOR Smart3D Sensor System** enables the flexible arrangement and combination of several 3D sensors for complete detection of the three-dimensional workpiece surface. The system is characterized by the simple integration of rugged, industry-compliant 3D sensors.

In order to avoid a stop of the conveyor system in the manufacturing process, our single shot technology in combination with the Universal Position Interface (UPI) enables scanning of moving workpieces.

Due to the active illumination, the density of the 3D data is independent of any distinct features of the workpiece surface. Unlike conventional stereo cameras, the ATENSOR Smart3D sensors provide dense 3D information even on homogeneous surfaces. The interference-free operation of several active sensors is ensured by a sophisticated decentralized synchronization mechanism (patent pending).

The industrial **ATENSOR Smart3D Sensor System** stands for a robust, easy to integrate and highly flexible solution for in-line digitalization in the manufacturing process.

The Technology

- 3D cameras
- active, structured light with random patterns

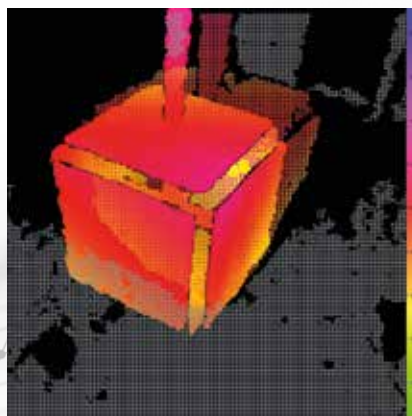
Fit for Industry

- flexible arrangement
- many possible configurations
- easy integration into the system

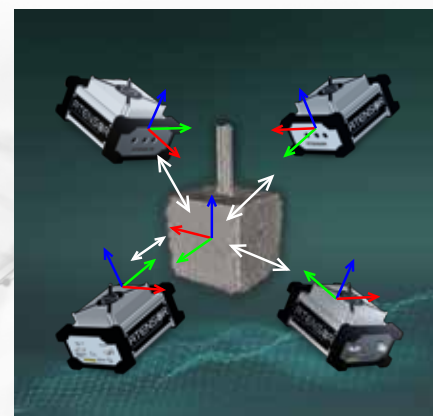
Together with the proven Lotsize 1 components from ATENSOR, the Smart3D Sensor System is the key technology for robot-based surface treatment.



Flexible arrangement of the sensors



Alignment of sensors with software support

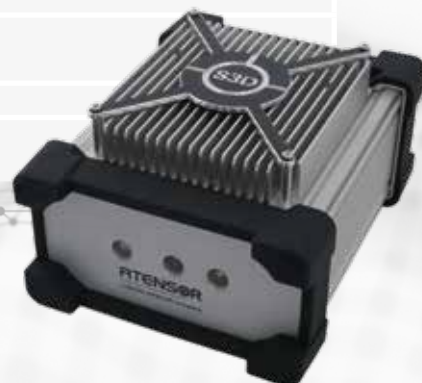


Fully automatic registration of the sensors to each other

Technical Specifications

ATENSOR Smart3D Sensor

Model	S3D-2E3
Measurement range	0,35 - 2 m
Technology	Active structured light
Illumination	Laser 830 nm
Laser class	Class I (EN60825-1)
Lateral resolution	640 x 480
Depth resolution @ 0.5 m	1 mm
Depth resolution @ 1.0 m	3 mm
Depth resolution @ 1.5 m	6 mm
Field of view @ 1 m	820 x 680 mm
Frame Rate	30 FPS / sensor
Embedded platform	Intel Celeron 2.0 GHz, Quad-Core, 4 GB RAM
Communication	Gigabit Ethernet
Positional information	Beckhoff ADS (native) PROFINET, EtherNet/IP, EtherCAT, and others (via Gateway)
Multi-sensor	Yes
Power supply	12-24 V
Power over Ethernet (PoE)	Yes
EMI	EN61000-6-4:2007 +A1:2011 EN61000-6-2:2005
Protection class	IP67
Temperature	0 - 40 °C



Components

ATENSOR 3D Scene Reconstruction

The 3D multi sensor system in combination with **ATENSOR 3D Scene Reconstruction** is the key to successful industrial in-line digitalization.

The entire information from the multi sensor system is processed by the **ATENSOR 3D Scene Reconstruction** in real time to generate a 3D model. Several million points per second are evaluated from different perspectives, filtered and integrated into the 3D model.

By intelligent utilization of the highly redundant information, the accuracy of the reconstructed 3D model is well beyond the accuracy of the raw sensor data.

The reconstructed 3D models serve as input data for all following Lotsize 1 components of ATENSOR.

ATENSOR 6D Localization

ATENSOR 6D Localization delivers the location and orientation of known workpieces in the three-dimensional image by means of matching the point cloud with the CAD data in six dimensions (3D position + 3D orientation).

Especially with regard to the application in ATENSOR Lotsize 1 systems, a complete CAD model is not required for the localization. In fact, a CAD excerpt with representative features (e.g., stable mounting points on all parts) is sufficient.

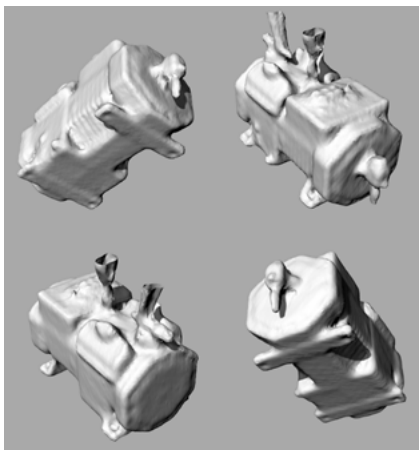
ATENSOR 6D Localization based on three-dimensional images offers significant advantages over conventional localization in two-dimensional images. Especially in situations where the workpiece contours are barely visible in two-dimensional images, the conventional systems reach their limits. This is where **ATENSOR 6D Localization** delivers much more robust results through its use of 3D data.

ATENSOR Parametric Matching

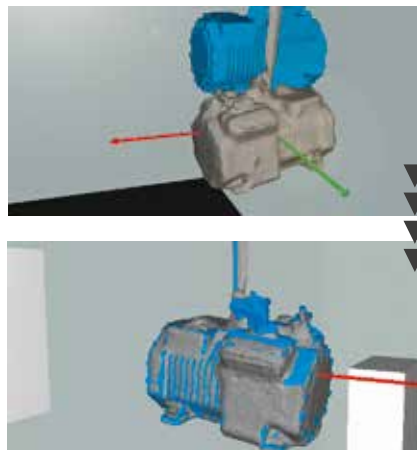
In many cases, the workpieces in the production mix differ only by a few parameters, such as, for example, cabinets of different sizes with otherwise identical characteristics. If these are manufactured on customer request, CAD data are often not available.

For such use cases, **ATENSOR Parametric Matching** as a special version of ATENSOR 6D Localization and ATENSOR 3D Part Recognition offers a solution for the detection and localization of parametric workpieces.

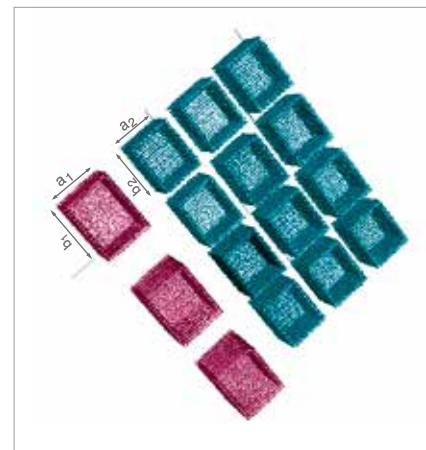
In addition to detection and localization, the **ATENSOR Parametric Robot Program Generator** provides an efficient tool for the automatic generation of robot programs, especially for parametric workpieces, even without availability of CAD data.



3D scene from different sensors



6D position detection – align scanned model with CAD



Application example "Parametric matching of boxes"

ATENSOR 3D Part Recognition

In addition to ATENSOR 6D Localization, **ATENSOR 3D Part Recognition** offers the possibility of recognizing the respective workpieces in a 3D scene based on CAD data in case of unknown arrangements and compilations of products.

Especially on manually loaded production lines, the exact composition and sequence of products is not known in many cases or only with some uncertainty (caused by errors) in the task.

ATENSOR 3D Part Recognition offers the ideal solution for these situations by automatically recognizing the workpieces currently being processed.

- workpiece recognition based on CAD data
- automated recognition of the workpieces currently being processed

3D PART RECOGNITION

ATENSOR Robot Program Adaption

ATENSOR Robot Program Adaption enables the combination of conventional robot programming with the advanced methods of *VISION based* surface treatment technology.

Conventional robot programming reaches its limits in presence of a large variation of the workpiece position or orientation (e.g., due to tolerances of the fixtures) or placement of the workpieces (e.g., manual loading of carriers). For these cases, **ATENSOR Robot Program Adaption** is the ideal solution in combination with conventional robot programming.

The conventionally generated robot programs are automatically selected on the basis of the workpieces that are detected and localized in the 3D scan and adapted to their respective position and sequence. The adaption goes far beyond a mere displacement of the workpiece coordinate system. The determination of the sequence, the ensuring of the reachability, the consideration of robot axis limits and the adaption to avoid singularities as well as collisions take place automatically. This way, conventionally generated programs can be safely and robustly adapted to a new workpiece position and orientation.

ATENSOR Robot Program Adaption relies on the existing tools as well as on the existing qualification of the operators, thus enabling the efficient implementation of highly complex robot processing solutions.

- determining robot path sequence
- ensuring reachability
- considering robot axis limits
- avoiding singularities
- avoiding collisions

ROBOT PROGRAM ADAPTION

TEACHSCANADAPTRUN

ATENSOR Automatic Robot Program Generator

The automation of production processes with a high number of variants is an especially demanding task. The conventional generation of specific robot programs for all variants occurring in the production mix must be regarded as uneconomical in most cases. The usual approach of grouping into families to handle similar workpieces with generic programs results in a reduced quality with higher unit costs. High quality combined with high process efficiency can only be achieved by using an individual robot program adapted to the respective variant. The solution for the efficient generation of individual robot programs is provided by the **ATENSOR Automatic Robot Program Generator**.

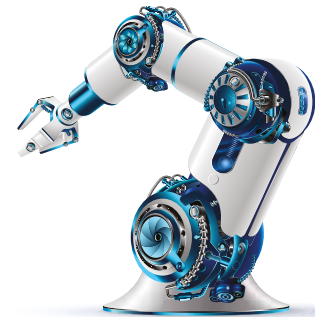
The **ATENSOR Automatic Robot Program Generator** abstracts the definition of individual robot paths and movements towards the definition of recipes. For the respective areas of the workpiece surface, only parameters such as path distances, angles of incidence, velocities, etc. are defined.

The actual path planning takes place fully automatically by applying the predefined recipes to the actual geometry of the workpiece determined by the 3D scan system. In addition to the actual process paths, both the spatial trajectories and the exact on/off trigger points for the respective process devices (for example paint guns) are calculated. Of course, the automatic calculation of the robot programs is carried out while ensuring reachability, consideration of axis limits, avoidance of singularities and collision avoidance. This means that the fully automatic robot programs can be safely executed on the robot without previous test runs.

The **ATENSOR Automatic Robot Program Generator** thus allows realization of real Lotsize 1 systems.

- high quality and high process efficiency
- efficient generation of individual robot programs
- ensuring reachability
- considering robot axis limits
- avoiding singularities
- avoiding collisions

AUTOMATIC ROBOT PROGRAM GENERATOR



ATENSOR Parametric Robot Program Generator

In many cases, the workpieces in the production mix differ only by a few parameters, such as control cabinets of different sizes with otherwise identical characteristics. Especially if these are manufactured on customer request, CAD data are very often not available.

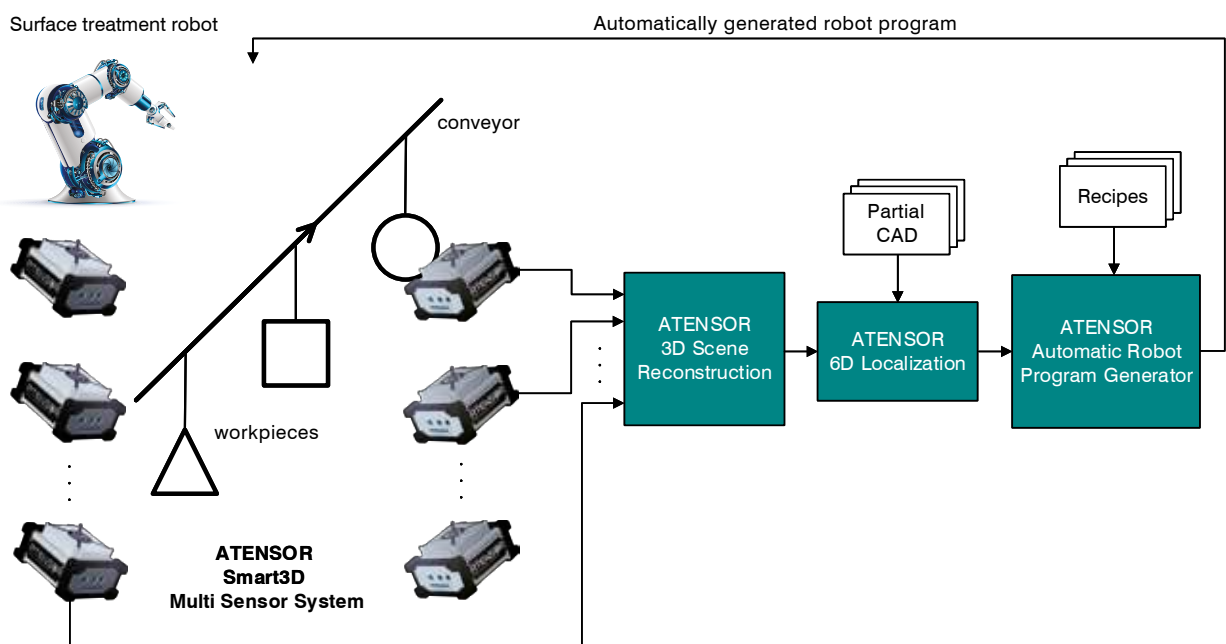
For these applications, **ATENSOR Parametric Robot Program Generator** provides a special solution. Together with the ATENSOR Parametric Matching component, it enables the fully automatic detection, localization and processing of workpieces, and thus the highly efficient robot-based automation of production lines with a high number of variants.

- fully automatic detection, localization and processing of parametric workpieces
- highly efficient robot-based automation of production lines with a high number of variants and without CAD data

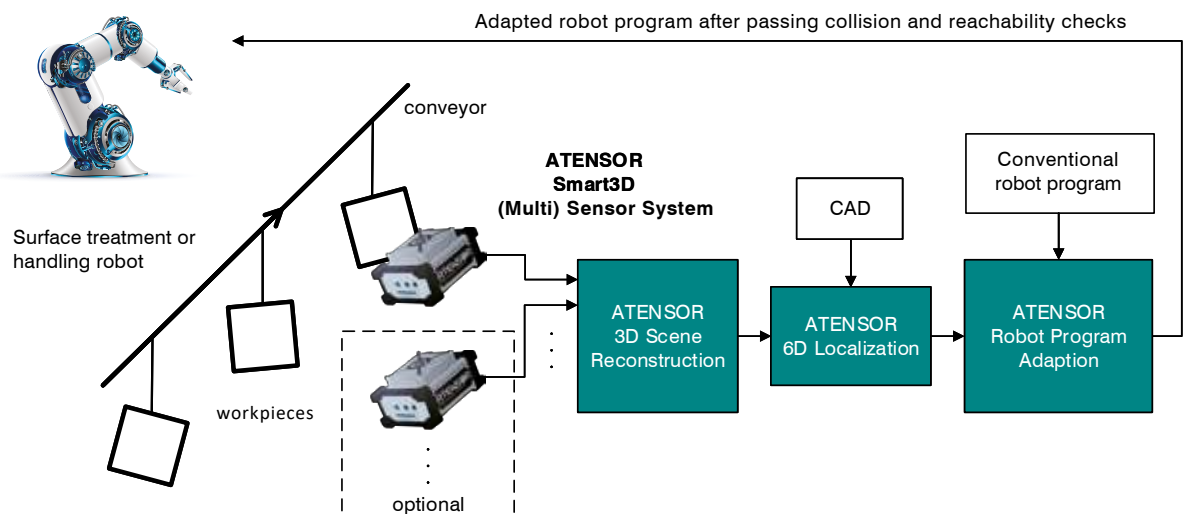
PARAMETRIC ROBOT PROGRAM GENERATOR

Mix and Match – Application Examples

Robot based surface treatment even at a high number of variants



Adaption of conventional robot programs based on the actual workpiece position



About Us

ATENSOR

is a dynamic, ambitious enterprise, operating from the Upper Austrian technology hub Stadtgut Steyr.

Since 2003, ATENSOR has been developing innovations which offer its customers unsurpassed integrated system solutions in the fields of automation and quality control.



ATENSOR – technology hub Stadtgut Steyr

The Journey

The young company ATENSOR Engineering and Technology Systems GmbH started its business on the initiative of some private investors – as a spin-off from the private research company Profactor GmbH.

From Research to Production

From a vision and the resulting research project, an innovative technology was brought to market – and successfully implemented in the industry.

Today, ATENSOR is a member of the renowned Micro-Epsilon Messtechnik Group (Ortenburg, Germany). ATENSOR acts as the competence center for robotics and robot-based measurement technology within the internationally operating Micro-Epsilon group. The company thus focuses on one of the most disruptive technologies of the future.

The company with its team of experts is undergoing a continuous growth process. At present, about 20 employees work at ATENSOR – mostly highly qualified software developers and engineers in the field of automation technology.

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COMPANY DATA

*“The whole is greater than
the sum of its parts.”*

Aristotle

ATENSOR

a MICRO-EPSILON company

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