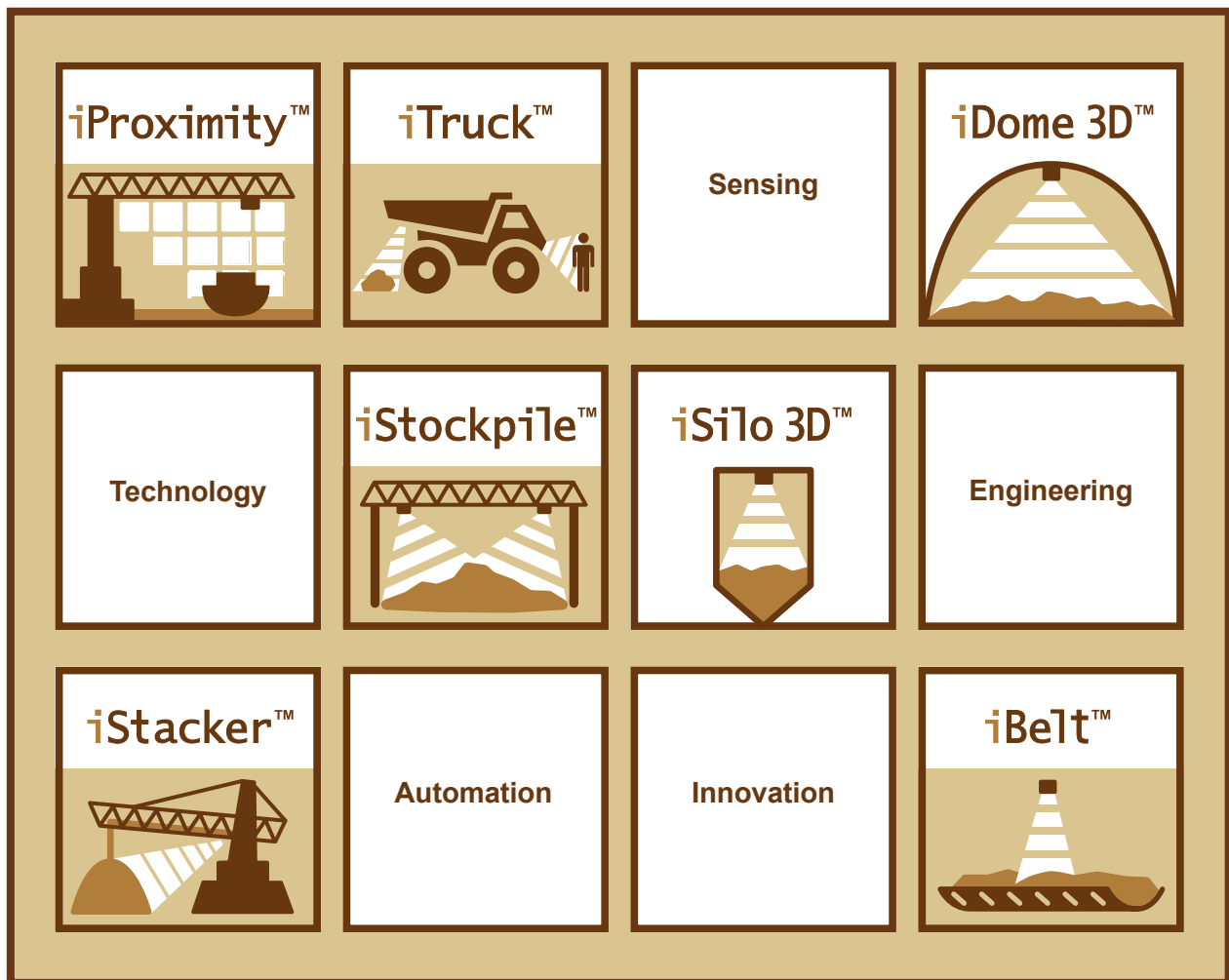
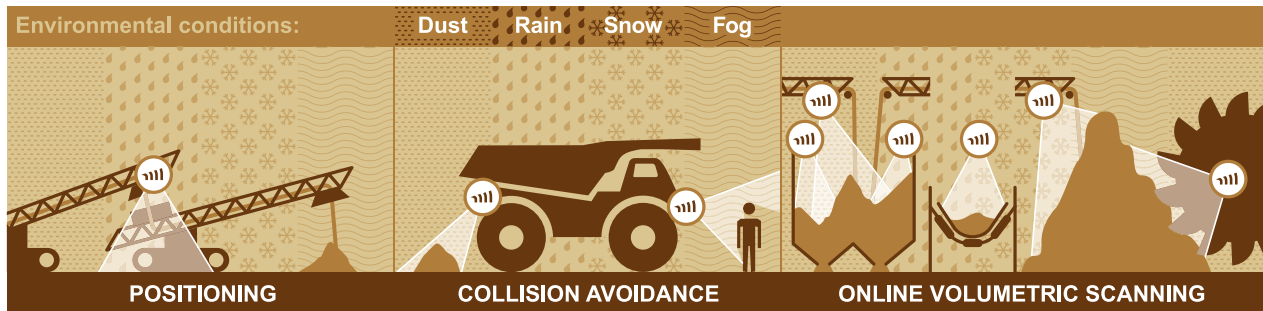


2D Radar Solutions

for safety and automation
in tough environments



Sensor System Application Range: Positioning, Collision Avoidance and Surface Profiling
Robust ▪ Reliable ▪ Real Time ▪ High Performance

FROM PIT TO PORT

indurad's radar technology is a multifunctional key technology for the mining industry.

Wherever rough environments can be found, radar is proven to be a superior solution for measurement and detection.

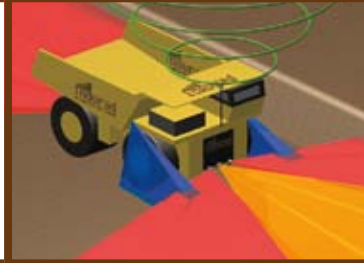
indurad has developed many solutions for the mining and material handling industry based on their unique requirements.

Functions and Applications

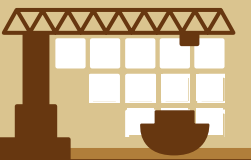
iTruck™



- Collision avoidance and unique productivity
- Reduced false alarms for operator assistance, no annoyance
- Fully integrated 2D radar, GPS, inertial, camera, color touch panel
- Blackbox incident memory, transparency and reporting
- Fast single shift installation



iProximity™



- Multipurpose application for machinery, stacker, shiploader, crane
- Electronic fence instead of tripper switch or lanyards
- Easy cell based multi collision zone definition and analysis
- 50x50m object localization area
- Whitelisting of non collision structures



iBelt™



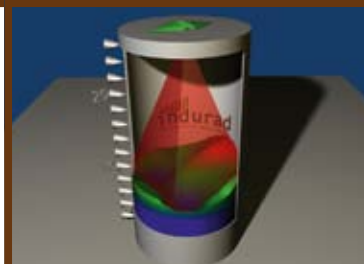
- World's first radar based belt volume scanner and speed sensor
- Worry free technology – works in dense fog and extreme dust
- Volume not mass is the limiting factor for belts, stockpiles, silos
- Combined with belt scale it delivers density measurement
- Unique fully integrated data analysis tool with trends and counters



iDome 3D™ iSiLo 3D™



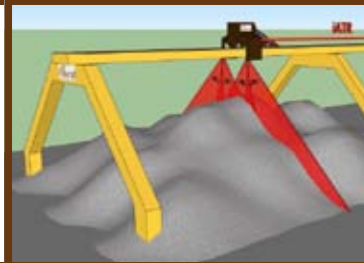
- World's first 2D/3D radar scanner for silo, bunker and dome
- Inventory control accuracy improved in large silos by >30%
- Fast measurement / real time processing cycles up to 15Hz update rate
- For high dynamic loading / discharging (apron feeder protection)
- Applicable in harsh conditions like cement clinker



iStockpile™



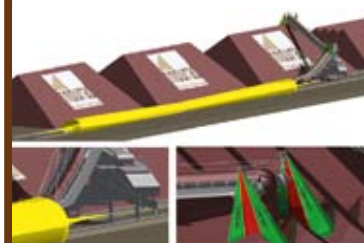
- 1D iATR overhead crane or tripper car location measurement
- 2D iDRR profile scanning with multiple sensors
- 3D online stockpile and bunker inventory control
- Flexible zone adjustments for different stockpile areas
- Applicable in harsh conditions like cement clinker



iStacker™



- 1D iATR stacker position measurement along the rail track
- 2D iDRR profile scanning from head of stacker / reclaimer boom
- 3D online stockpile inventory control
- Telecommanding and automation by full process transparency
- Flexible zone adjustments for different stockpile areas



FROM ARCTIC TO DESERT

indurad offers a variety of different standardized solutions. The solutions highly customizable to meet the specific needs of our customers around the world in different industries. indurad offers an extended variety of interfaces from 4...20mA to TCP/IP. The iWEB™ Technology allows an easy installation and parameterization as well as an advanced user interface.

Customer Benefits

- Full 150m range state, adaptive passive obstacle detection
- Tip head + crusher reversing assistance plus camera backup
- Lane assistance and windrow / berm localization
- Sensor fusion and redundancy by passive sensing and GPS
- Aerial picture map overlay, 4GB logging, reporting, analysis



- Totally independent of weather and environmental conditions
- Full collision avoidance not bubble based proximity detection
- Easy to install and parameter
- Object tracking and identification
- Blackbox functionality allows scenario analysis



- For short conveyors, high inclination, apron feeders
- Contact less sensing of belt volume flow and belt speed
- Over the belt installation – not in the belt installation
- Single easy calibration and fast integration
- Online data analysis tool with counters, trendcharts, shift reports



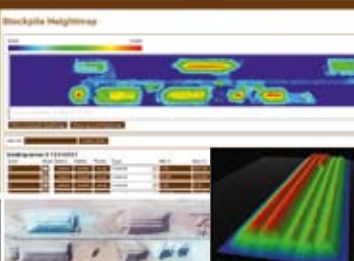
- High volume accuracy due to custom container and surface modeling
- 3D visualization for material distribution over draw points
- Zero maintenance with only one initial parameterization required
- Alarm system for empty apron feeders
- Unique fully integrated data analysis tool with trends and counters



- Permanent online status of heap / stockpile information and history
- Draw point control without manual health & safety critical gauging
- 3D visualization for material distribution and improved dispatching
- Automated shift / weekly / monthly / quarterly / annual reports
- Unique fully integrated data analysis tool with trends and counters



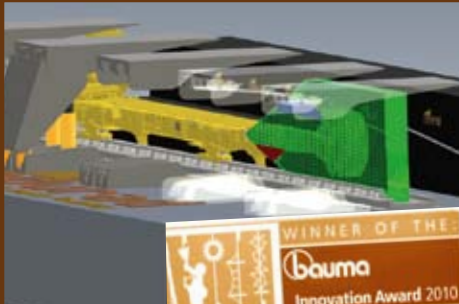
- 3D Information and volumetric information about the stockpile
- An effective dump height control and dust mitigation
- Collision avoidance stacker / infrastructure / vehicles on trajectory
- Exact position of the stacker with +/- 0.05m up to 1500 m distance
- Unique fully integrated data analysis tool with trends and counters



ENGINEERING SOLUTIONS

Sophisticated solutions for demanding customers. indurad is a strong partner for OEMs and end customers. We engineer tailor made solutions, specially designed for the individual machine type. We primarily serve customers from the mining, the material handling, construction and metallurgy industries.

Shearer Loader Collision Avoidance (CAS)



Challenge and Objectives

- Narrow longwall environment and high radar selectivity
- High dust, extreme mechanical shock and vibrations
- Flame proof ATEX design for underground coal

Solution

- iProximity Base Software Package
- Special inclination compensation software extension
- Special roof support mapping and adaptive ranging arm control
- Support for patenting and system documentation



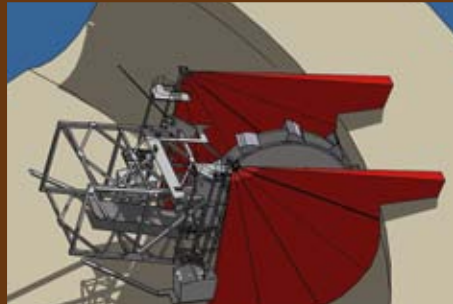
Conclusion

This cutting edge solution won several awards, including the RAG Coal Mine Research Award 2009 and the bauma Innovation Award 2010.

Customer Benefits

- Large step to functional safety and teleremote operations
- Increased productivity by controlling coal flow in tunnel section
- Reduced mechanical damage on cutting drums / lost picks

Bucket Wheel Excavator Predictive Cutting Control



Challenge and Objectives

- Very high accuracy requirements due to machine dimensions
- Large raw data amounts of 12 iDRR Sensors
- Special calibration procedures due to large 100m high machine

Solution

- iStacker Base Software Package
- Differential GPS + surface scan Gauss-Krüger data fusion extension
- Mine database real time exchange interface
- iProximity obstacle localization near of boom and bucket wheel



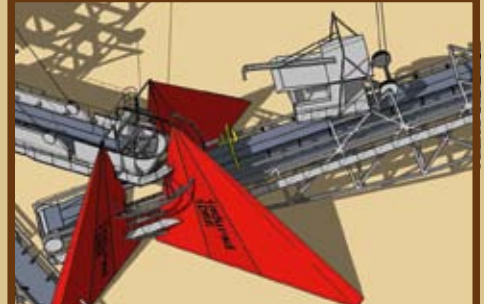
Conclusion

Solution works 24hr, 365days per year even under dense fog conditions, where operators foremost need assistance.

Customer Benefits

- Predictive volume flow information and operator assistance
- Online 3D mine model update reducing manual surveying
- Smooth slowdown - no hard shut-off by lawn lards / tripper switch

Loading Unit Automation & Transfer Point Positioning



Challenge and Objectives

- Synchronism at flexible transfer points of IPCC
- Operator positioning assistance and full automation mode
- High dust and vibrations at transfer points

Solution

- iPositioning Engineering Package
- Passive radar reflector pattern recognition module
- Motion modeling and data fusion algorithm
- PLC control interface for automatic mode



Conclusion

indurad achieved breakthrough compared to other technologies like laser and ultrasonic who failed in the testing and evaluation process.

Customer Benefits

- Minimize re-positioning times and loss of production
- Crew size and task optimization for operator + service personnel
- Reduced corrective movements and less collisions with belt frame

TECHNOLOGY

indurad Solutions are complex, robust and innovative. The unique solutions are truly high-tech for the field, having been developed for the tough requirements of the mining industry. indurad is not just a sensor manufacturer but an integrated solution provider. indurad plays a pioneering role in development of innovative products based on hardware, software and engineering. indurad is leading the market with it's 2D/3D radar based solutions.

Hardware The indurad Dual Range Radar™ iDRR is indurad's core product. It is the only 2D/3D radar scanner on the market. Our solutions are based either on the iDRR standalone or on multi sensor concepts.



Dual Range Radar™ iDRR

A unique radar sensor with 50° visibility and up to 150m range. The compact 210x130x80mm sensor operates in the high precision scan band of 77GHz, where it can focus 3x more than classic level radar sensors. It's 15Hz scan speed allowed to be used in dynamic environments for process control and automation.

Doppler Velocity Radar™ iDVR

Measures precised velocities and determines at the same time the linear distance to the target. Using monopulse methods, it can estimate the angle to single objects. Contrary to other sensors, the iDVR can measure slow moving objects (<0.1 m/s).

State Measurement Unit™ iSMU

A compact box including an individually configured set of small state sensors. It can contain an electronic compass for orientation measurement, GPS for position estimation, multi axis inclinometers and multi axis acceleration sensors. The sensor package allows inertial stabilizing functions on dynamically moving machines.

Active Transponder Radar™ iATR

Is a sensor system for distance measurement in tough environments. It allows linear positioning and speed measurement of tripper cars, cranes and other moving machinery with an accuracy better 0.05m up to 1500m.



Radar Processing Unit™ iRPU

All sensors are connected to the iRPU which is the central processing unit. It can be equipped upon customer's request with different interfaces. It is fan less and suitable for high altitudes and hot & humid environments.

Industrial Interfaces

Additional to the iWEB™ indurad offers several industrial interfaces, like:

- 4...20 mA
- Ethernet/WLAN
- Ethernet IP
- Digital I/O
- Socket TCP/IP
- Profibus DP
- RS 232, 422, 485
- Modbus TCP/IP
- CAN-Bus

indurad customizes protocols and telegrams to a customer's infrastructural needs.

Software Our software, both sensor firmware and application software, has been developed for industrial use. It is robust, reliable, fast and scalable. Based on the application area, one or several different software modules are used.

indurad's operating system, which runs on the iRPU, is based on the real-time linux kernel, and contains only essential libraries for robust industrial use.

iFramework™

The iFramework™ Technology is a modular industrial grade C++ toolbox proprierarily developed by indurad for sensor interfacing, signal processing, data streaming, logging, modeling and output interface control. Application specific plugins (e.g. for surface profiling, collision avoidance, positioning) can be added.

iWEB™

The iWEB™ human machine interface (HMI) is an easy to use web application to avoid a cost intensive SCADA integration. It allows secured access to all required information for setup, parameterization as well as visualization and process analysis.

It also supports complex 3D visualizations for stockpiles. The process data visualized in the browser is live and updated by using a push principle real time update technology. Multiple clients can connect simultaneously, and user access levels are differentiated from operator to maintenance manager.



indurad

in|du|rad (tech.): INDUstrial RADar
in|du|ra|re (lat.): make hard, harden, improve

Hightech For The Field

indurad is the only supplier who develops, manufactures and integrates efficient, compact and robust industrial 2D radar sensor and integrates them into efficient turnkey 2D/3D solutions. Since the start of the fundamental technology development, which commenced in 2003 at RWTH Aachen University, we have been growing fast and have become a global SME enterprise, with an extensive high-tech network to universities as well as industry research and third party sensor manufacturers.

Strong Partners

indurad is a German based global player. Our philosophy is providing our customers the best performance products in combination with the best local support. We selected strategic partners around the world by their ability to understand customers' needs and to design the best solution for them. Our partners provide fast response and local support.

Customer Focus

Customer satisfaction is the center of our attention. We provide our systems to solve a customer's challenges. Our code of conduct states: We have to provide the best solution on the market to the customer. If we cannot, we will recommend other companies to take the business. indurad believes in longterm business relations based on trust.

Highly Qualified Employees

indurad is a team of highly qualified experts with different educational backgrounds, including mining engineers, electrical and automation engineers, computer scientists, high-frequency and signal processing engineers, and also field service engineers. This strong team allows us to understand and satisfy customers' demands. We believe in diversity and build a team with flattening hierarchies to archive customer satisfaction, innovate new products and improve existing solutions.



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Local Partner

