
razorlabs
Sustainable LIB Production
empowered by Artificial Intelligence

Achieve operational excellence

Maximize Productivity
using QC/QA, RCA, PdQ

Improve Sustainability
meet regulatory targets

Agility
Modular production lines

Our Impact

Saved >$130M for our clients

>200 hours of downtime prevented

Over 300M product inspections

Tier-1 Clients

vector

BHP

muratec

western power

NEWCREST MINING LIMITED

AICL

SIEMENS

FMG Fortescue The New Force in Iron Ore

WEIR

razorlabs

Industrial AI Disciplines

Time Series Data

Deep Learning driven platform for large-scale data analysis, prediction and optimization

Root-cause Analysis, Predictive Maintenance and process optimization

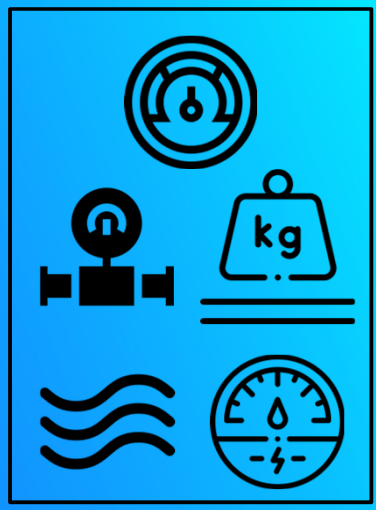
Vision Data

Real-time video analysis platform for vision applications using Neural Networks

Visual Inspection - QA/QC

Time Series Data

Sensors Data



Solution Flow

Data Collection

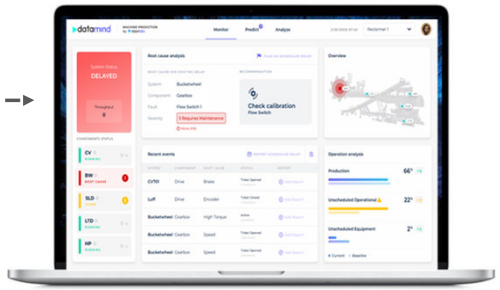
Sensors, PLC, SCADA, MES, ERP, Process Engineer, Planner

Training Neural Networks

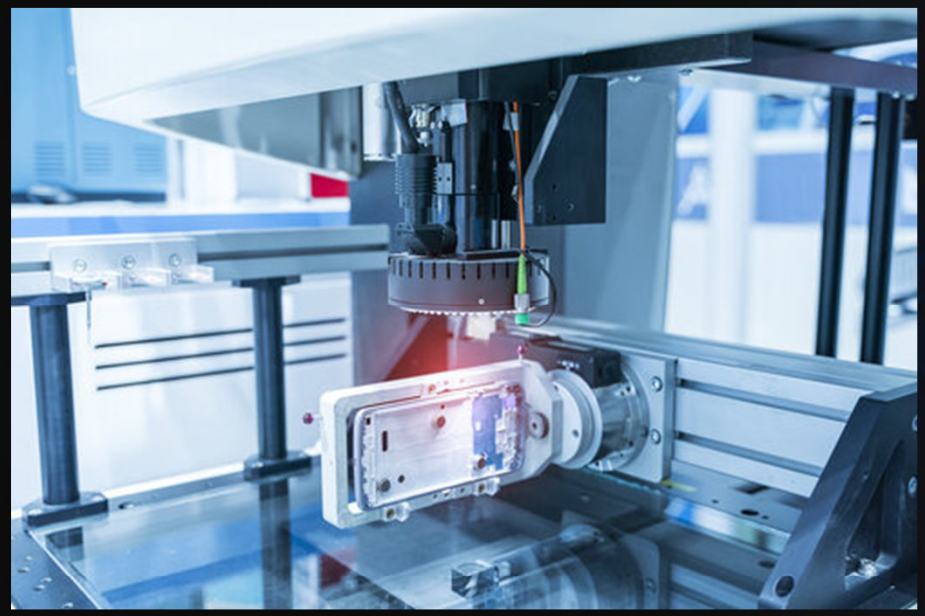
AutoML Neural Networks to identify hidden patterns in the data

Predictive Analytics

Predict failures and increase operational excellence

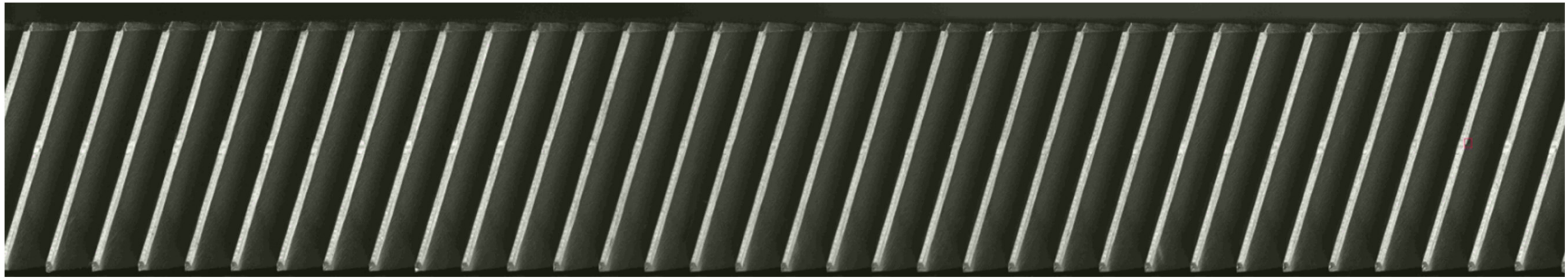


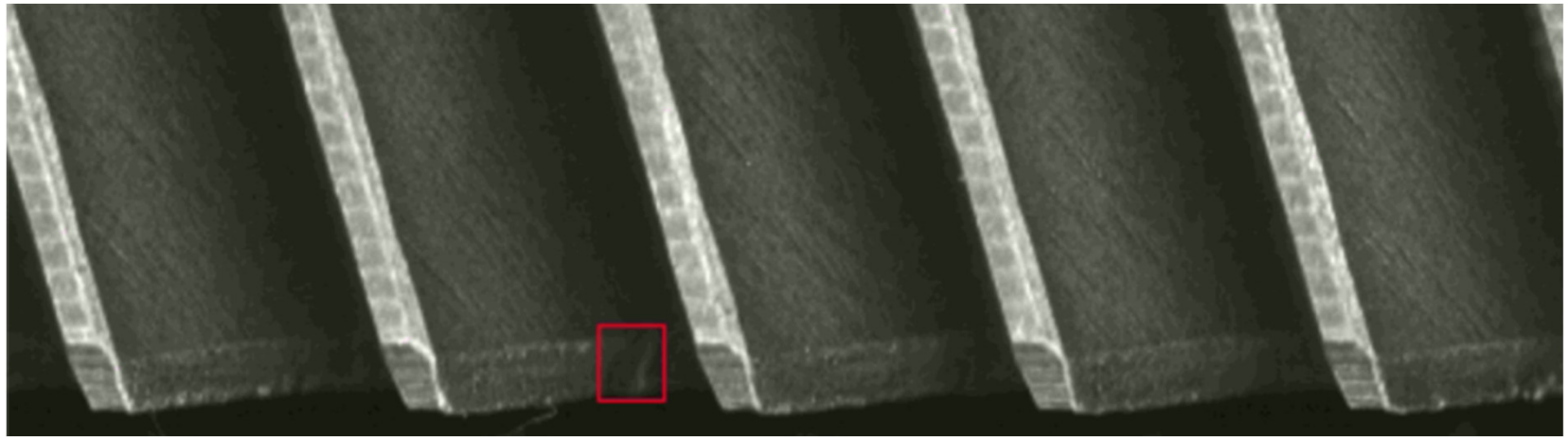
Vision Data for QA & QC

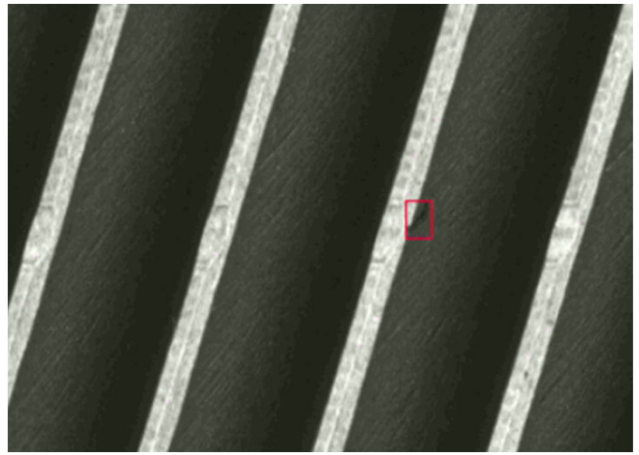


Automotive Bevel Gears

MUSASHI





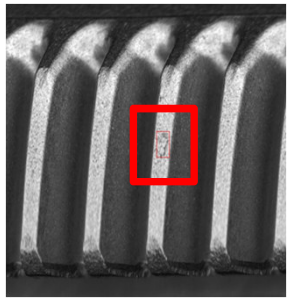


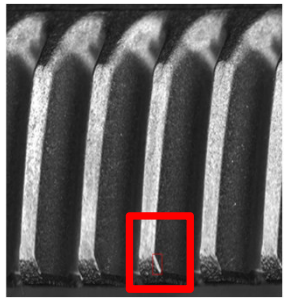
Automotive Bevel Gears

Challenge

Automatically discover defects (most of them tiny) during the production process of metal gears using existing cameras.

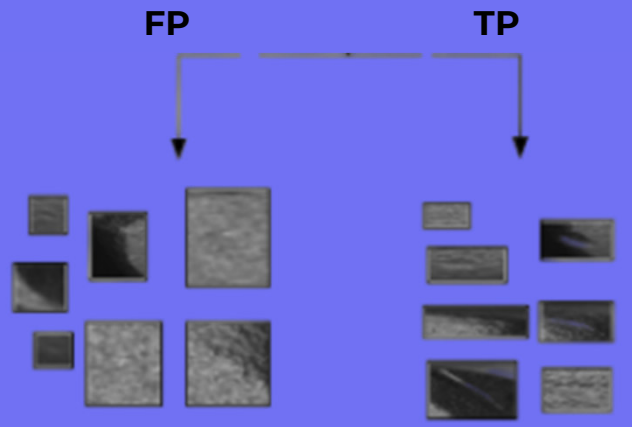
- Very few (~10s) examples of defects
- Customer must be able to self-train new gears
- Difficult textures





Clear Value

Discover almost unnoticeable defects in multiple patterns



Case Study – Automotive Gears

Clear value

- **100% recall -** all defects were detected
- **>92% specificity** - only 8% of all good parts were sent for manual evaluation
- **Focus human attention** on ambiguous cases
- Can be **deployed in various stages** of the manufacturing process
- **Evolving AI:** Add new types of gears, and new types of defects.

Clear Value

~5x lower manual QA/QC time

100% recall
>92% specificity

LIB PRODUCTION

“by 2028, the pouch cell sector is expected to reach 1,000 GWh. In comparison, in 2017, it was only 100 GWh.”

https://www.eetimes.eu/challenges-and-trends-in-sustainable-battery-manufacturing/

MARKET CHALLENGES

70%-90%

Low Yield
New production lines

https://www.eetimes.eu/challenges-and-trends-in-sustainable-battery-manufacturing/

No Trained Personnel
Shortage of engineers

High Energy Process
High consumption

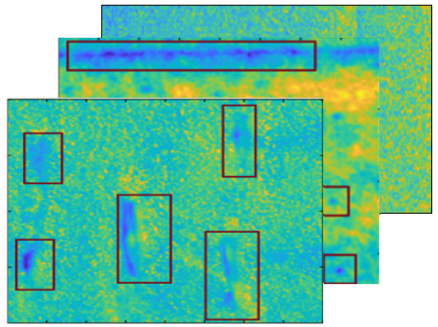
Costly Production
30%-40% of EV price is the battery cost

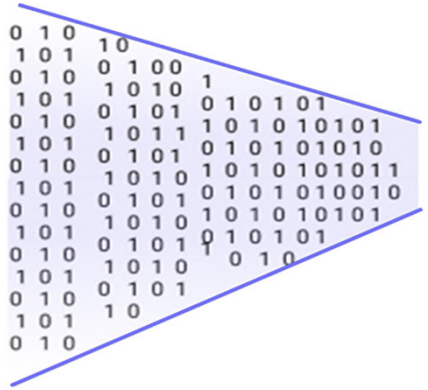
https://www.spglobal.com/marketintelligence/en/news-insights/blog/top-electric-vehicle-markets-dominate-lithium-ion-battery-capacity-growth

Our Paradigm: Predictive Quality

2D & 3D sensors

PLC, Sensors, Actuators

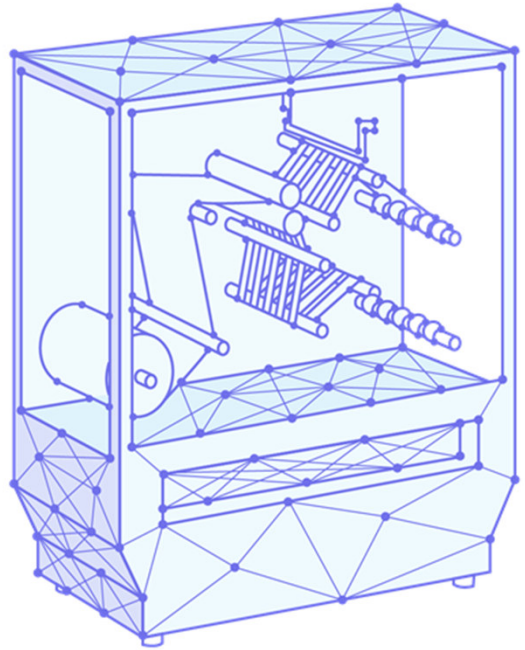




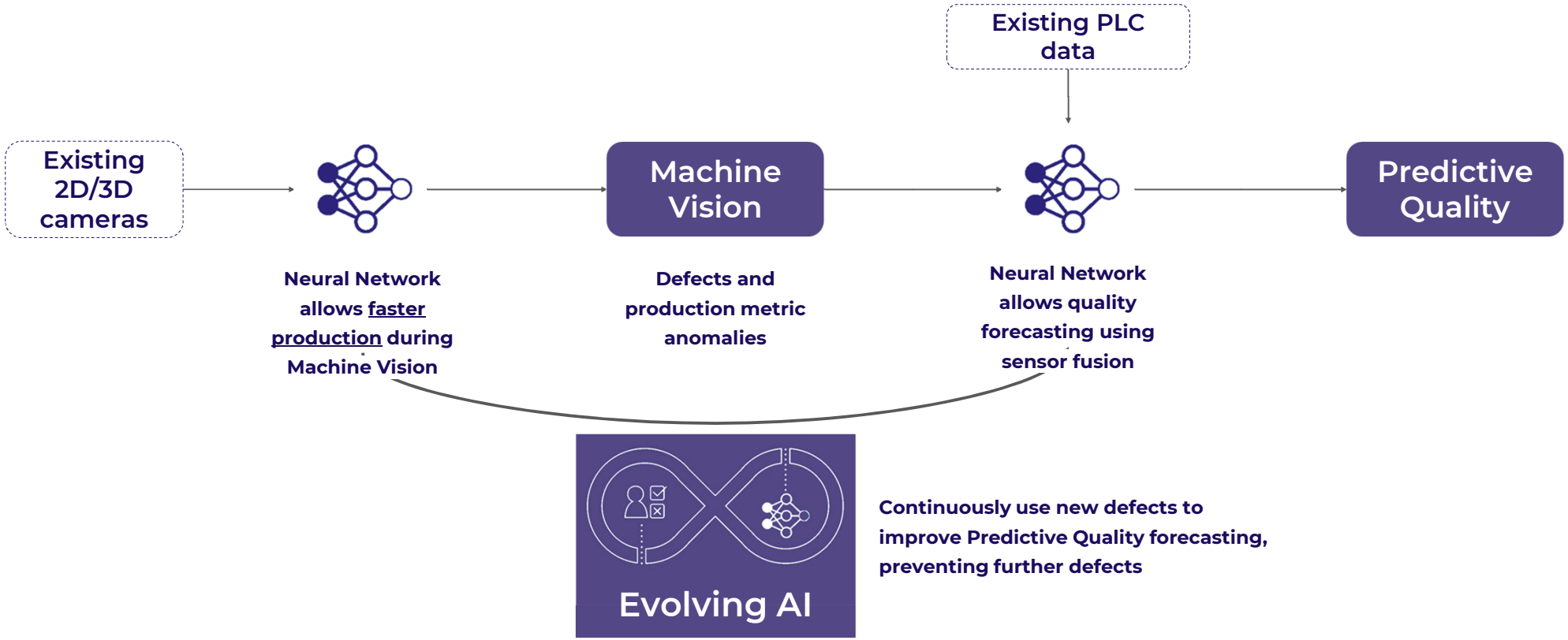
Inspection AI

DataMind AI

Predictive Quality



Industrial Autonomy



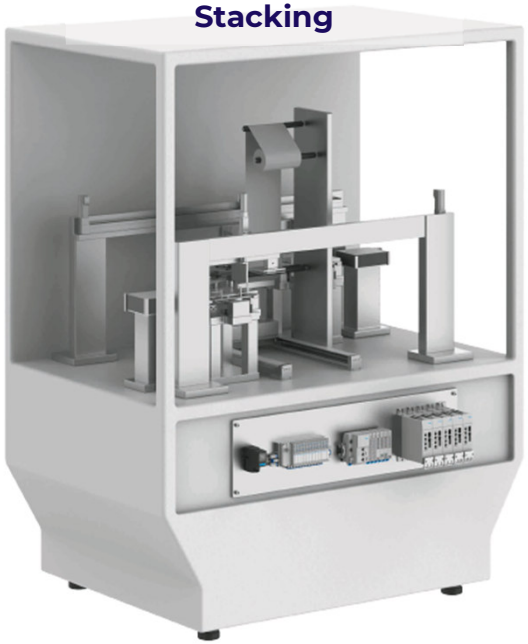
Our Scope - Standalone Application

Our Scope - Machine Level

Our Scope - Holistic, Process Level

Slitting

Stacking



Electrolyte Filling

Machine Vision for Gauging and Inspection

Time Series Data for PdM and RCA

MES & ERP data for Predictive Quality

Razor Uniqueness

Same hardware, stronger insights

Utilize existing sensors and cameras

Evolving AI

Accuracy is improved with time

Holistic Autonomy

Data and vision fusion leveraged for insights

Selected Potential Use Cases

POTENTIAL USE CASES IN ELECTRODE PRODUCTION

CHALLENGE

PH and temperature controlled planetary mixers require precise homogenization to keep the slurry purity and to avoid agglomeration, gas inclusions and slurry viscosity. Slurry properties may vary from mixing to coating processes

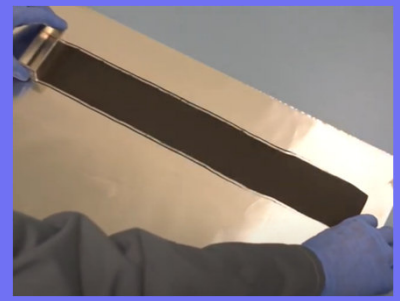
SUGGESTED SOLUTIONS

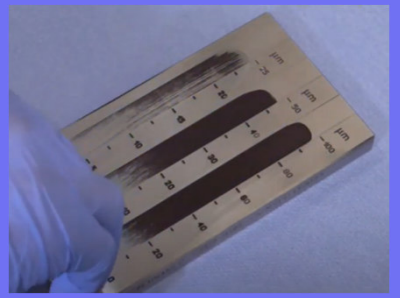
- Monitoring the mixing and dispersion sequence, while maintaining shape of the mixing and stirring tools
- Quality Control of PH value and agglomerate measurements
- AI based models simulating online the slurry quality to verify purity and homogenization

VALUE

- Reduce slurry mixing time
- Improve purity and homogenization
- Extend equipment lifetime and reduce maintenance time

SLURRY MIXING



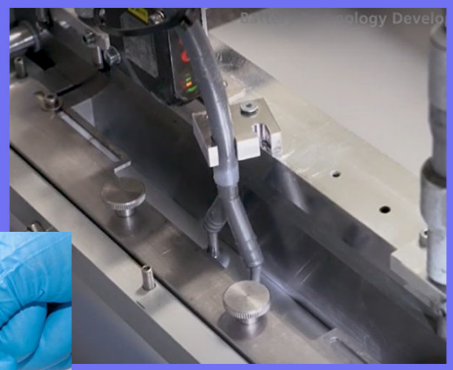


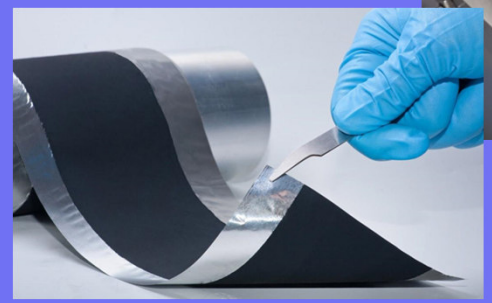
POTENTIAL USE CASES IN ELECTRODE PRODUCTION

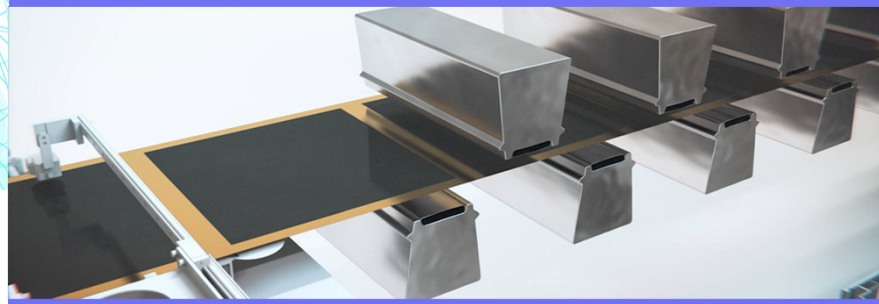
COATING

CHALLENGE

Wet-coating processes on current-conducting foils with film thicknesses of 10-20 µm. The wet film thickness ranges from 150µm to 300µm. In order to ensure the exact thickness film and due to the asymmetry of thicknesses before the drying process, scrap and waste can occur. Furthermore, foreign particles may accrue and degrading the coating quality. Coating is a mechanical acceleration sensitive process







SUGGESTED SOLUTIONS

- Using AI based machine vision to detect and verify the wet coating thickness, weight, width and alert on defects.
- Collecting time series data from coating injection volume and film conveying speed to predicted scrap and anomalies

VALUE

- Reduction of scrap
- Energy conservation of machine use

POTENTIAL USE CASES IN ELECTRODE PRODUCTION

DRYING

CHALLENGE

The quality of the drying processes profoundly affects the uniformity, consistency, safety, and cycle life of the manufactured battery. Non-uniformity or defects introduced at this stage on either side of the electrodes will result in poor electrochemical performance of the battery and can cause serious safety issues.

SUGGESTED SOLUTIONS

- Using AI based machine vision to detect and verify the dry coating thickness, weight, width, fractions and alert on defects.
- Based on time series data of ovens temperatures and coaters processes parameters coating losses can be predicted.

VALUE

- Optimize coating thickness to match anode and cathode productions
- Optimizing the solvent use and recycle efficiency
- Reduction of scrap

POTENTIAL USE CASES IN ELECTRODE PRODUCTION

CALENDERING

CHALLENGE

Calendaring is a density sensitive process. Porosity, the adhesion strength and the conductivity of the layer should be carefully monitored to optimize performance of the cells. malfunctions in this process may cause burrs which eventually give rise to internal short circuits in the cells.

SUGGESTED SOLUTIONS

- Using AI-based machine vision to provide coating quality inspection as well as gauging the coating width to ensure that electrode sheets meet exact specifications before they are separated by an insulator.
- Time series data collected from the calendar rotations speed, torque and vibration to predict required maintenance

VALUE

- Increase in yield and reduction of scrap – fixing issues on the fly
- Reduced downtime

POTENTIAL USE CASES IN ELECTRODE PRODUCTION

CHALLENGE

While slitting, burrs and buckles may occur, those defects can significantly increase safety issues along the formation process due to internal shorts.

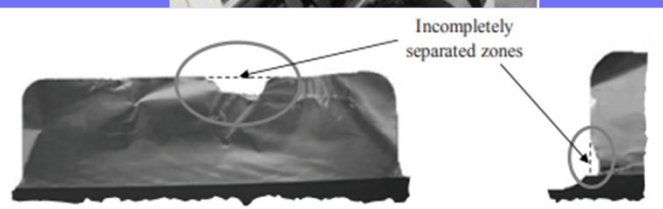
SUGGESTED SOLUTIONS

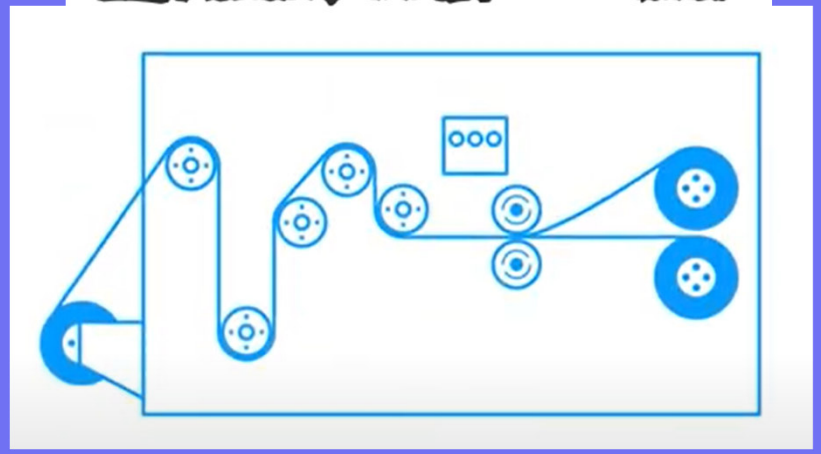
- AI-based machine vision to provide cutting quality inspection and detection of burrs and contamination of the foils.
- Time series data collected from the laser/die cutting action, temperature, coating thickness, cutting blades and process parameters to predict maintenance needs

VALUE

- Minimizing downtime due to prediction of maintenance incidents
- Increase in coils' quality based on online feedback from vision system
- Increase safety and mitigate short circuits risks

SLITTING MECHANICAL/LASER





POTENTIAL USE CASES IN ELECTRODE PRODUCTION

CHALLENGE

electrode tab cutting, tab welding, protective taping, tab gluing or laser cutting to be prepared for the winding process require high precision. Tabs should be spaced carefully. The quality of the electrode ear cutting and tab welding can have an impact on the electrical contact property of the cell

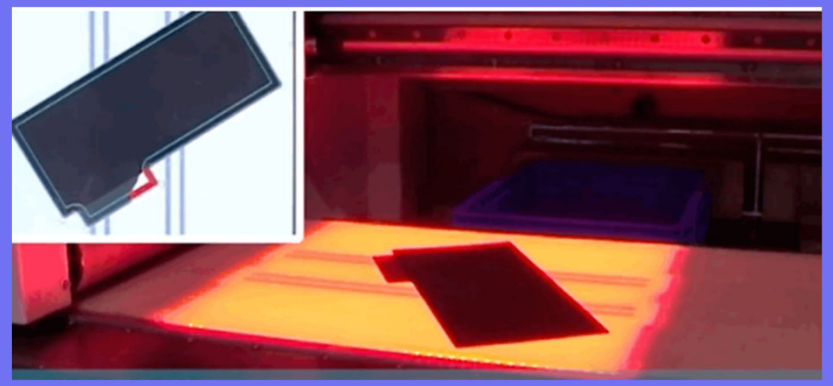
SUGGESTED SOLUTIONS

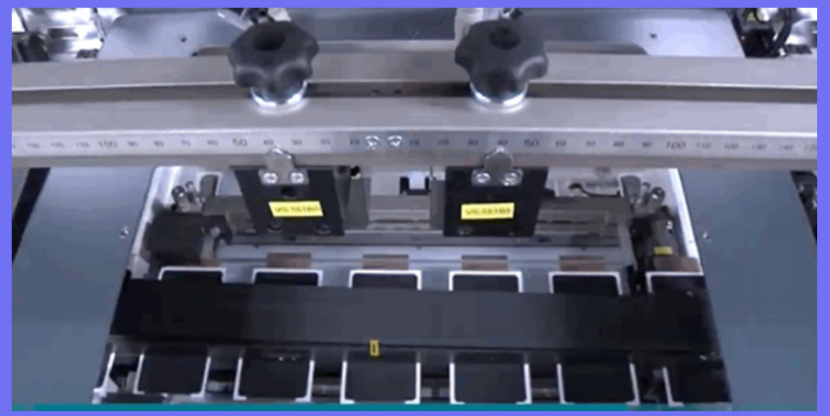
- AI-based machine vision to provide gauging of the tabs spacing, tab welding and tab glueing
- Time series data collected from the tabbing machine process parameters to predict maintenance needs

VALUE

- Minimizing downtime due to prediction of maintenance incidents
- Increase yield and battery lifetime
- Increase safety and mitigate short circuits risks

TABBING





POTENTIAL USE CASES IN CELL ASSEMBLY

CHALLENGE

During the automated cell assembly, positioning accuracy of the anode and cathode sheets may vary.
Assembly is a mechanical acceleration sensitive process.
Furthermore, a constant web tension of the separator should be achieved.

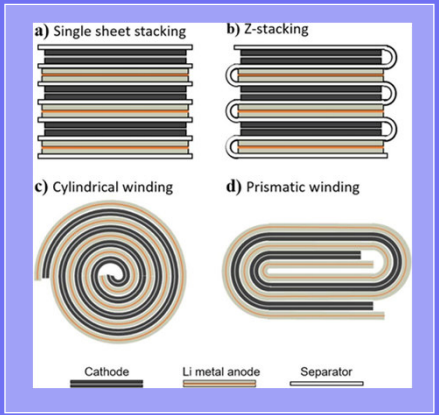
SOLUTION

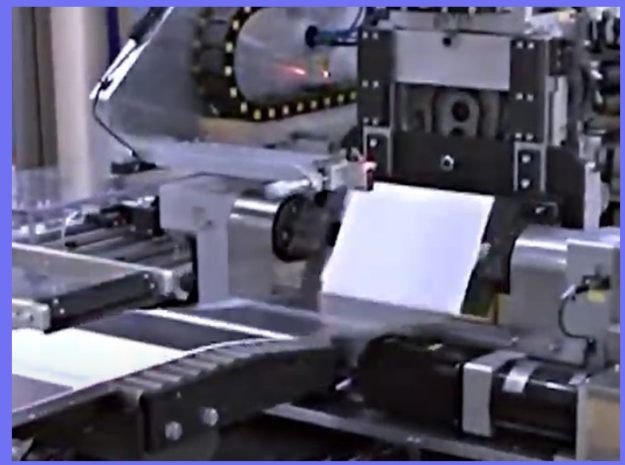
- AI based machine vision to position the exact location of each anode and cathode
- Web tension is recorded and analyzed together with the machine process parameters
- AI based machine vision to verify the number of sheets in each cell

VALUE

- Increased battery lifetime and energy storage
- Minimizing machine downtime through accurate maintenance prediction
- Reduce safety risks

STACKING, WINDING, Z-STACKING





POTENTIAL USE CASES IN JELLY ROLL INSERTION

CHALLENGE

Electrode layers wrapped to create as many energy-producing layers as possible.
Trapped gas produces the “pillowing” effect, which can decrease performance, or worse: the battery can leak, cause damage, or even explode.
Moreover, jelly role to case insertion is a violent action, it may cause defects

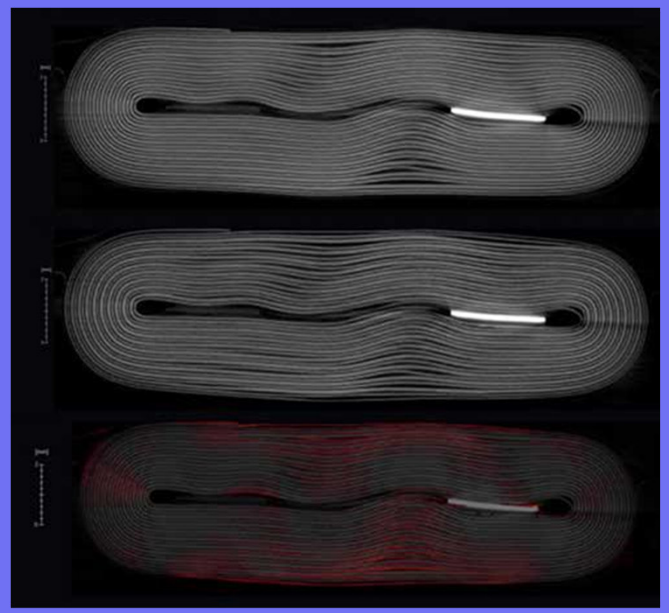
SOLUTION

- X-Ray machine vision to detect defects and waviness
- AI based predictive maintenance

VALUE

- Electrode assembly should be able to better tolerate pillowing if and when it does occur
- Reduce unplanned machine downtime
- Reduce safety hazards

JELLY ROLL TO CASE



POTENTIAL USE CASE IN CELL ASSEMBLY

CHALLENGE

Electrolyte may change capacity after first few charges and discharges, hence, should be very carefully and accurately injected. Sealing the cell is done by heating or either welding is a challenging process due to the sensitivity of the cell.

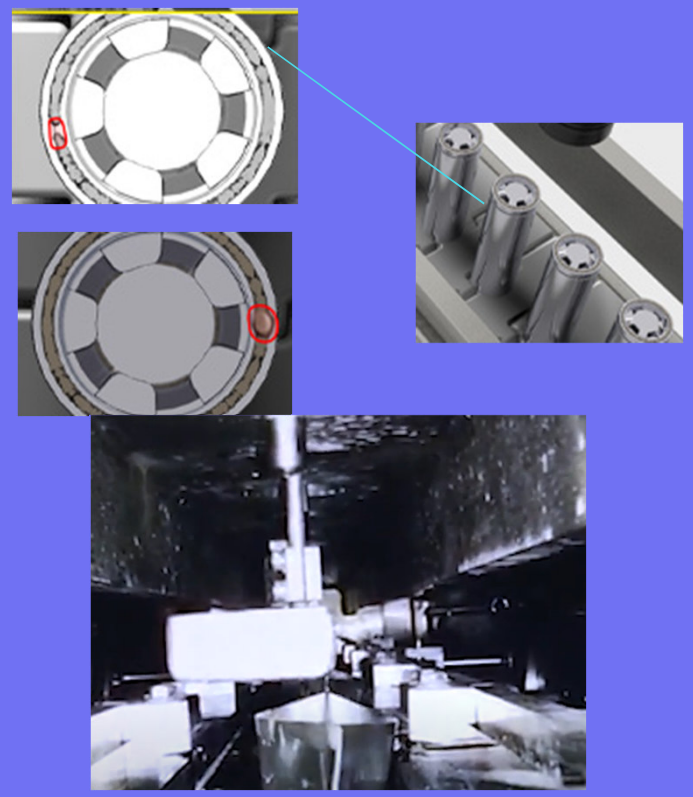
SOLUTION

- AI based machine vision to gauge, inspect and measure the sealing process
- Time series temperature, pressure, flow and PPM sensor parameters collected and analyzed to predict malfunctions

VALUE

- Increase safety by validating the sealing process
- Reduce downtime due to predictive maintenance

ELECTROLYTE FILL



POTENTIAL USE CASE IN CELL ASSEMBLY

FORMATION

CHALLENGE

Battery formation is currently the main bottleneck in the battery manufacturing process.
The charge and discharge cycles that activate the material in a newly assembled battery cell or pack can take up to 20 hours
Each battery develop a bit different SEI (Solid Electrolyte Interphase)

SOLUTION

- AI based machine vision to determine the location and size of the SEI layer
- Time series parameters collected from the aging and forming power supplies to provide expected SEI layer

VALUE

- Increase battery lifetime, more cycles due to more electrolyte
- Reduce testing aging time period
- Early detection of high self discharge and mismatched capacity or impedance

We are Razor Labs

“UTILIZE DEEP LEARNING TO UNLEASH THE POWER OF INDUSTRIAL AUTONOMY”

Partner with the biggest AI chips manufacturer

One of the most innovative AI companies in the world

Listed on Tel-Aviv Stock Exchange (TASE:RZR)

2016	Year Founded	65+	Project Completed	2	Offices: Israel & Australia

THANK YOU

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