

Industrial AI

Industrial automation based on auto ML and GANs to address predictive maintenance, quality control and optimization





- 1. About Conundrum
- 2. Solution overview
- 3. Cases
- 4. Technology deep dive
- 5. Conclusion

About Conundrum



Conundrum Industrial Limited is an international technology company focusing on research in AI and development of its proprietary machine learning technologies and software products for industries. Backed by Speedinvest, Austrian based VC.

Overview

17 completed projects

3 deployments

Wins in industrial competitions: Schneider, Aramco, Gazprom Neft, CERN

About Conundrum



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Improving Industries Performance



Reduce maintenance costs & improve throughput

Reduce manufacturing costs

Eliminate quality escapes

Predictive & prescriptive maintenance

Manufacturing process optimization

Quality control

Solution Overview

Conundrum System Provides the Following Solutions:



- Predictive & Prescriptive maintenance
- Quality control
- Industrial processes optimization







Equipment sensors: Temperature Pressure Vibration Acoustics Amperage etc.

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Equipment sensors: Temperature Pressure Vibration Acoustics Amperage etc.

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Measurements in laboratories: Chemical analysis Product quality tests

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Temperature Pressure Vibration Acoustics Amperage etc.





Conundrum



Training in Cloud & Deployment in Cloud



Training Module in Cloud Automated Preparation of Solution



Factory / Asset / Company Data Center Production

Equipment

Automation System

Industrial Protocol



Training in Cloud & Deployment On-Premises



Training Module in Cloud Automated Preparation of Solution



Factory / Asset / Company Data Center Production



Industrial Protocol





Training Systems



Automated Machine Learning

Conundrum Cloud automatically prepares a model for specific equipment

Delivers max benefit extracted from industrial data

Transfer Learning

Conundrum Cloud enables to use models experience and transfer knowledge from pretrained models

Inference Systems



Permanent Control & Improvement in Production

Auto monitoring keeps the performance under control

Permanent updates keep the system up-to-date

Production Ready

Conundrum Inference Module provides API to simplify integration & deployment

Packed into container enabling platform independence

Experience

17 Successful Cases Across Industries



Industries



Paper tears prediction on paper mill

Kappa number (paper quality) prediction on paper production Chemical



Predictive maintenance of chemical production equipment

Prediction of produced product quality

Optimization of chemical plant operating modes

Digital twin of chemical production



Predictive maintenance of submersible pumps in oil wells (upstream)

Anomaly detection of pumps (downstream)

Prediction and classification of drilling rigs failures events (upstream)

Metal & Mining



Quality prediction of coal in coal enrichment process

Optimization of coal enrichment process

Defects detection and classification of metal sheet during zinc coating

Predictive maintenance of welding equipment

Solved cases

Case: Large-Diameter Pipes Manufacturing

Challenge

Manufacturing process downtime due to welding equipment (DSAW) failure.

Tasks

- Predict failures of welding equipment
- Detect causes of potential failures
- Speed up check-ups and maintenance







Demo Conundrum PdM for Pipes Manufacturer

Case: Coal Enrichment Optimization

Overview

Coal mining and processing enterprise with coal enrichment factory. It sustains quality issues of coking coal which leads to losses.

Tasks

- Predict coal quality (ash conc.)
- Provide real-time recommendations to adjust control parameters to improve product quality







Predictive Maintenance of Pumps

Challenge

Pumps downtime and extra maintenance costs due to abrupt breakdowns. Pumps quantity is hundreds of units. Avg. breakdown events per year is 3.

Tasks

- Predict abnormal behaviour of pumps several days before breakdowns
- Detect causes of breakdowns
- Speed up check-ups and maintenance







Chemical Production Optimization

Conundrum

Challenge

Fertilizer manufacturer has issues of low quality of product which is estimated as a P2O5 concentration.

Tasks

- Predict P2O5 conc. in the output of flotation 1 hour in advance
- Recommend control parameters adjustment to keep the conc. into required range





PdM of Paper Mill

Challenge

Failures of paper mill happen which lead to paper tears and downtime of the whole mill.

Tasks

- Predict failure of the mill;
- Recognize possible causes of failures.







Technology

Training Module





Training Module





Training Module













Technology Workflow

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Conundrum Technology Workflow

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Inference Module





Conundrum

Preprocess Data Sensor, Labs normalization, API Inference denoising, and Cameras cleaning, data flow **Online learning** measurements frequency normalization, delayed signals handling 11111 Nvidia GPUs

Nvidia Docker

Inference Module





Inference Module





Conundrum

Permanent Improvement In Production



Conundrum enables to keep the performance of it's models under control and permanently improve the performance using new data.



Permanent Improvement In Production



Performance



Transfer Learning Impact



Precision/Recall curve for

- Traditional supervised (light blue);
- Traditional unsupervised (blue);
- Conundrum solution (red);
- Pretrained Conundrum solution using transfer learning (green).

Conundrum Transfer Learning technology enables to leverage other datasets from similar cases to boost the performance of the solution.

Here the solution has been pre-trained using the data from 3 other pumps (from energy industry), 1 year.

Mathad	Aree		Max F1		Recall = 0.8				
Method	Area	Prec	Rec	F1	Prec	Rec	F1		
Conundrum + TL	0.70	0.74	0.53	0.62	0.46	0.80	0.59		
Conundrum	0.49	0.44	0.69	0.54	0.37	0.80	0.50		
Trad. superv	0.29	0.23	0.97	0.37	0.21	0.80	0.33		
Trad. unsuperv	0.28	0.28	0.49	0.35	0.20	0.80	0.32		







Conundrum is targeting to become a leader provider of AI powered automation solutions for industries helping industrial companies to leapfrog into an Industry 4.0 era and attain the next level of intelligent control.

Questions?

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