



EFFICIENCY THINKING

## AI-based OPTIMIZATION SOLUTIONS

For Industrial Digital Transformation

GENUINE-AI OPTIMIZATION OF CEMENT FACTORIES

Optimization of the use of Alternative Fuels

OFICEMEN WEBINAR, 13/July/2021 - Javier A. García – Founder

# Have you ever...

**Found difficult to save energy costs?**

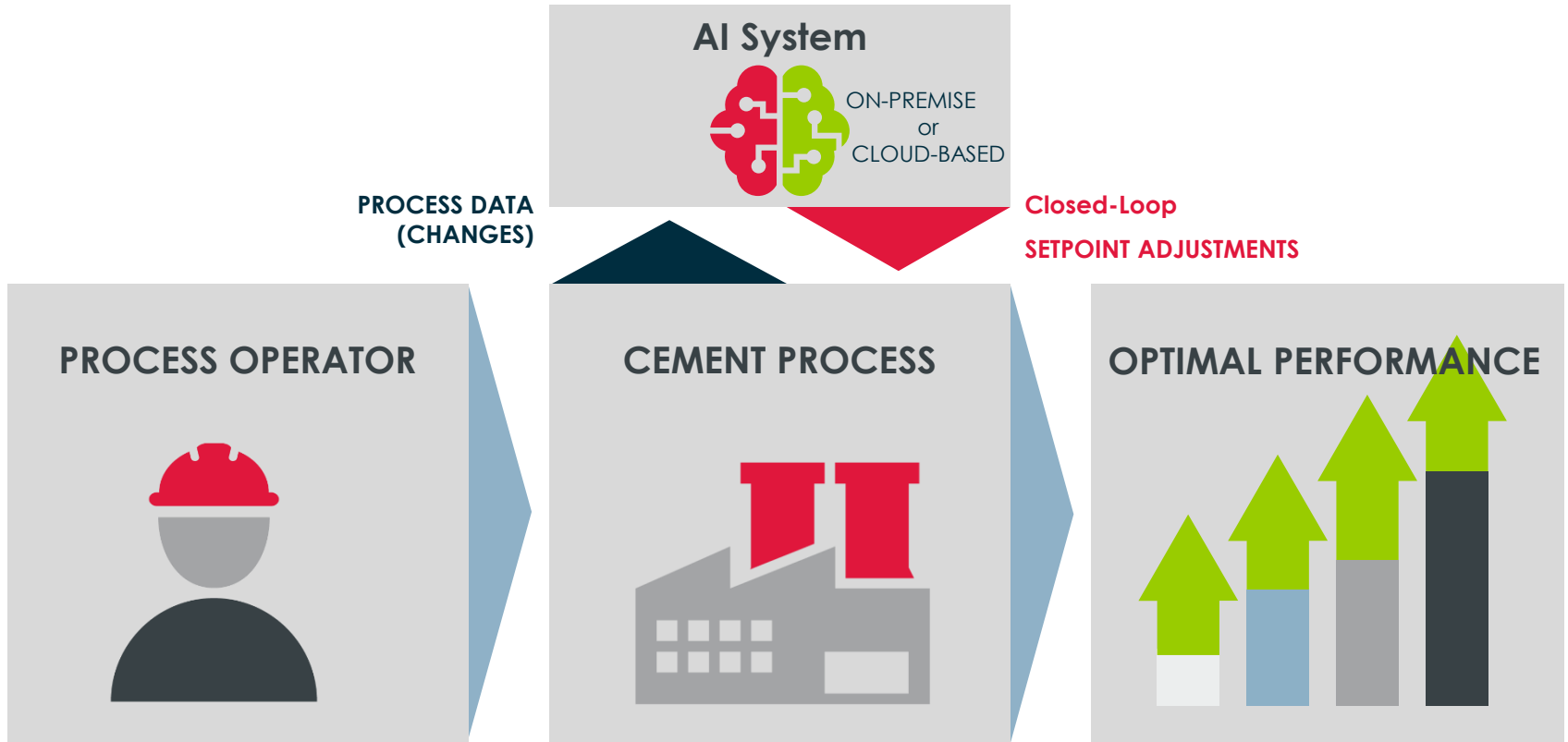
**Lost operating experience when older operators retire?**

**Suffered stability or quality problems for unknown reasons?**

**Struggled to keep emissions below limits?**



# Solution: AI in closed-loop



# OPTIMITIVE implements AI-based Cognitive Optimization in Industrial Operations

**OPTIBAT is our product, operational since 2011**



Power generation



Cement production



Oil and gas



Chemical



Paper production

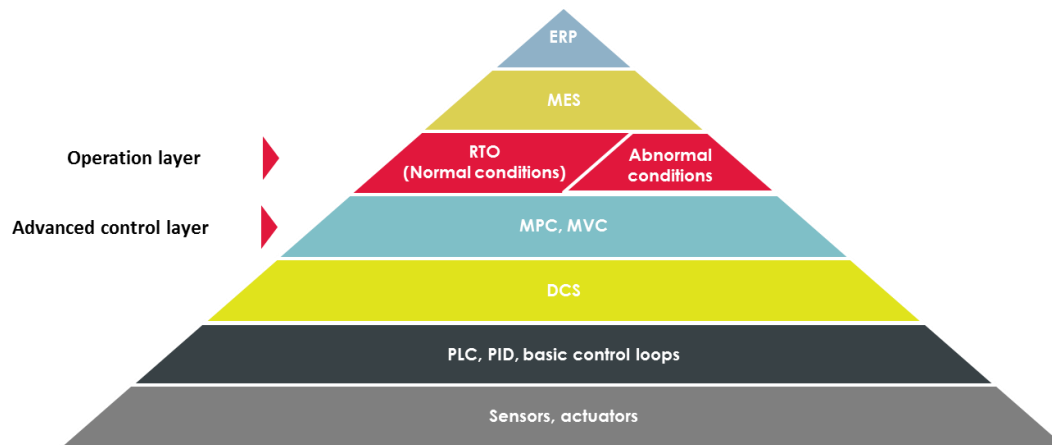
## OPTIBAT

### MARKET DRIVERS

- Digital Transformation
- Industry 4.0

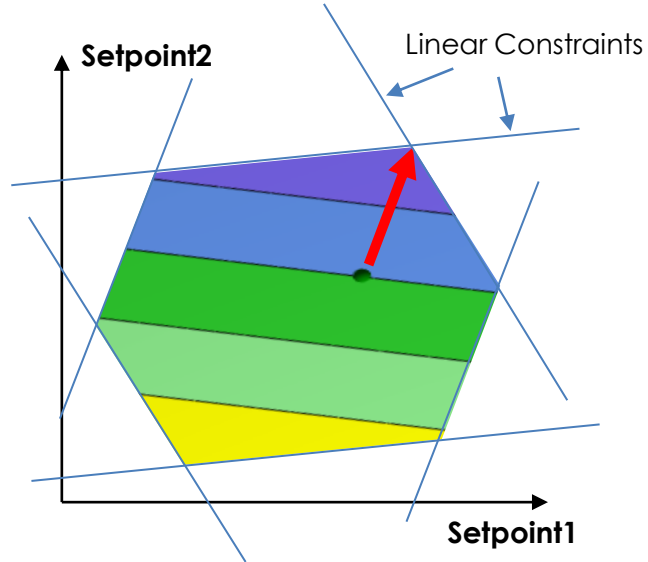
- ✓ Throughput
- ✓ Product quality
- ✓ Energy saving
- ✓ Runnability
- ✓ Stability

# Real Time Optimization (RTO) in the Process Automation hierarchy

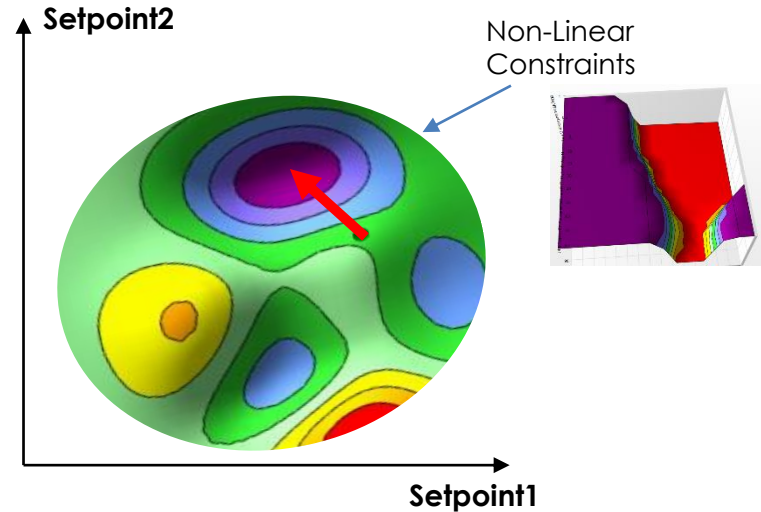


RTO (Real-Time Optimization) sits on top of the Advanced Process Control (MPC or MVC) or directly over the DCS. It proposes setpoints for controllable variables that must be reached by the underlying controls.

# Traditional Vs Cognitive Optimization



**Traditional Optimization**  
with Linear Model and Linear  
Constraints



**Cognitive Optimization**  
for the same problem, with non-Linear  
Physical Model and non-Linear Constraints

# “ AI will be a “must-have” in the Operation of Cement Plants ”

## Genuine AI:

Easy to maintain

Self-learning

Adaptive

Ubiquitous (Cloud/Edge)

Simple

Precise

Meaningful

# What makes Genuine AI for Optimization different from other Industrial AI?

AI Optimization is a very technical domain. Focus and experience is needed.

It requires special type of modelling – Cognitive Physical Models.

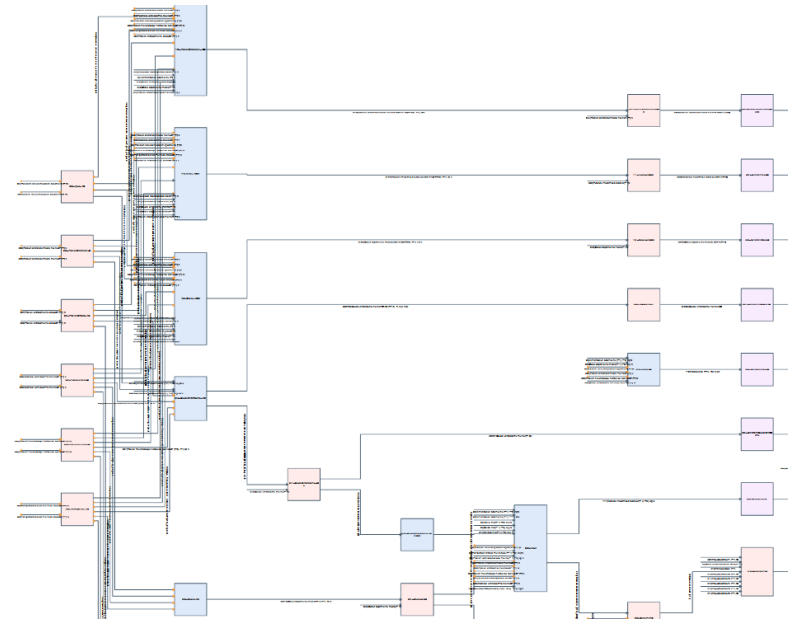
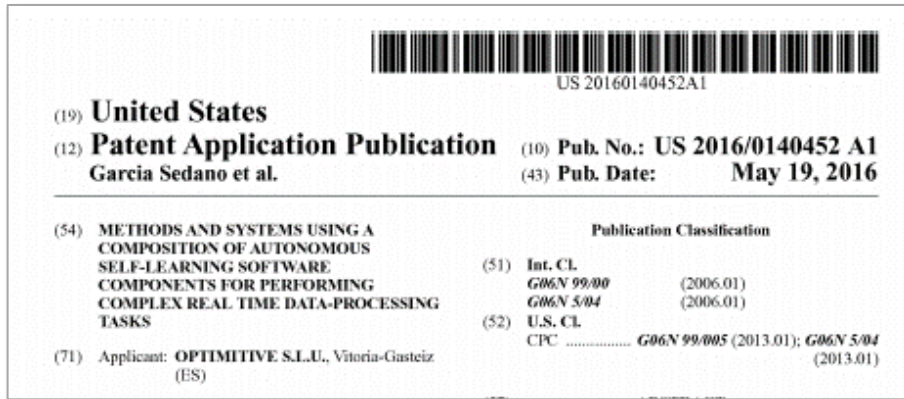
“AI for all” does not work here.





# USA Patent «Skill Composition»

Our patented technology makes the difference



Sophisticated solutions can be deployed without need of coding, in a graphical way

# OPTIBAT CAD for sophisticated AI solutions

## Without OPTIBAT AI/ML programming

- Bespoke, manual coding
- Hard to maintain and upgrade

```
File Edit Selection View Go Run Terminal Help
anomaly_quantify x
VARIABLES
  local
  special variables
  function variables
  class variables
cov = array([[1., -0.5],
            [-0.5, 0.8]])
from sklearn.mixture import GaussianMixture
from sklearn.datasets import make_regression, make_spd_matrix
import matplotlib.pyplot as plt

def compute_cdf_hypersphere_radius(x, cdf):
    quant_transformer = QuantileTransformer(output_distribution='normal')
    gauss_mixture = GaussianMixture(covariance_type='full')
    x_q = quant_transformer.fit_transform(x)
    gauss_mixture.fit(x_q)
    cov = gauss_mixture.covariances_
    x_q = np.matmul(np.linalg.pinv(cov), x_q.transpose()).transpose()
    hypersphere_x_q = np.sum(x_q**2, axis=1)
    return hypersphere_x_q

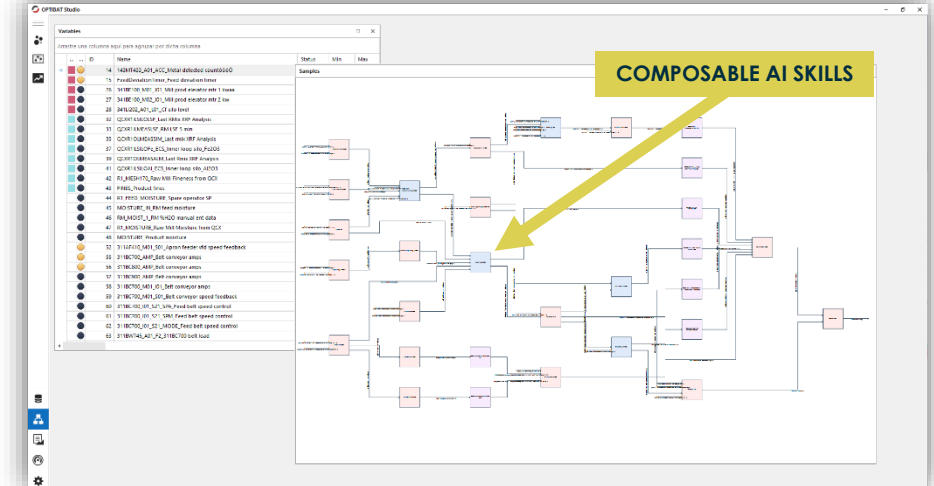
def get_inner_samples(x, proportion_samples):
    """
    Returns the indexes of the inner samples
    """
    hypersphere_radius = compute_cdf_hypersphere_radius(x, 0)
    sort_idx = np.argsort(hypersphere_radius)
    sel_idx = np.sort(sort_idx)[int(np.ceil(x.shape[0]*proportion_samples)):]
    return sel_idx

def get_outer_samples(x, proportion_samples):
    """
    Returns the indexes of the outer samples
    """
    hypersphere_radius = compute_cdf_hypersphere_radius(x, 0)
    sort_idx = np.argsort(hypersphere_radius)
    sel_idx = np.sort(sort_idx)[-int(np.ceil(x.shape[0]*proportion_samples)):]
    return sel_idx

if __name__ == '__main__':
    x, y = make_regression(n_samples=1000, n_features=2)
    if x.shape[1] == 2:
```

## With OPTIBAT: No-Code visual design

- Visual and perfectly documented
- Easy to understand and maintain

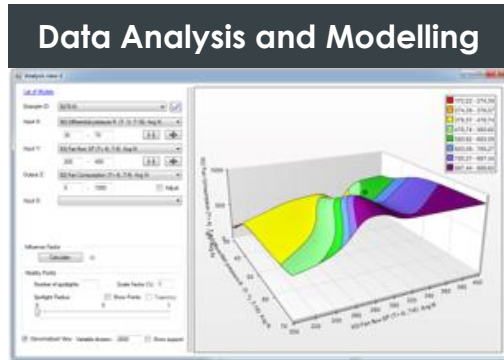


# OPTIBAT Suite: Studio & RTO

“AI-CAD tool for Process Engineers”

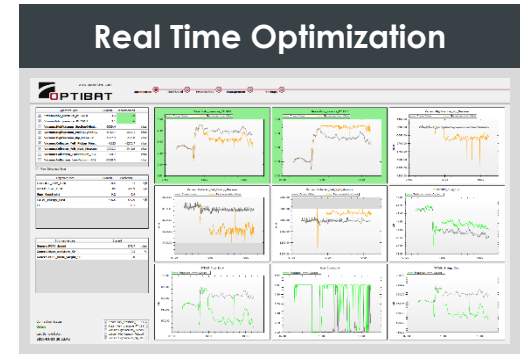
“AI-Assistant for Process Operators”

OPTIBAT® Studio



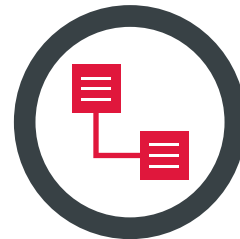
No-code Data Science

OPTIBAT® RTO



Autonomous Optimization of selected KPIs.

Common algorithms  
& knowledge



# OPTIBAT<sup>®</sup> RTO: Solution in open-loop & closed-loop



Constantly monitors, learns, analyses, improves

# OPTIBAT

On Premise or in the Cloud

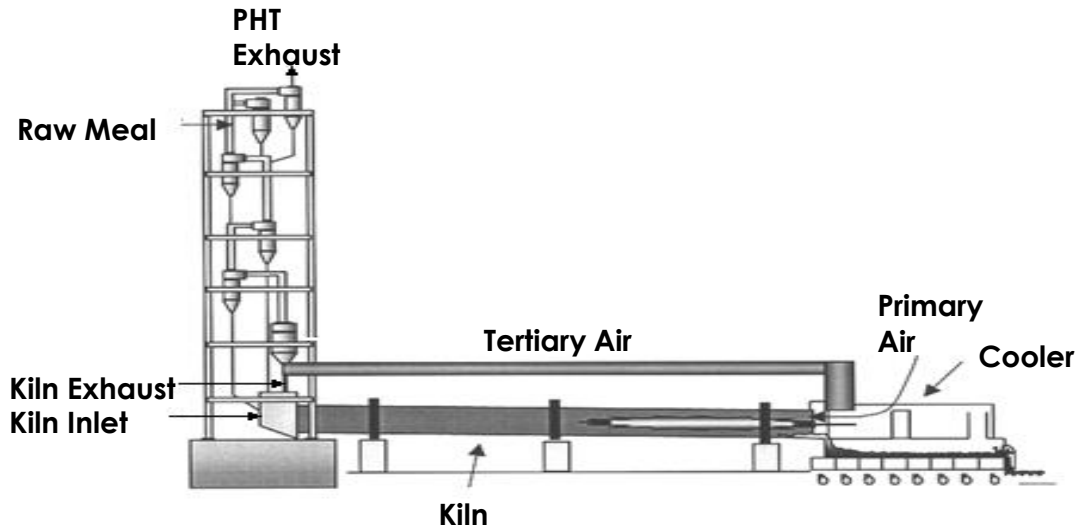
**Standards:**  
TCP/IP, OPC,  
SQL, OCR, XML,  
ODBC, ...



# Kiln Optimisation

## Typical achievable improvements

Kiln		
Throughput	3% to 6%	increase
Energy	2% to 5%	saving
FCaO	> 90%	in range

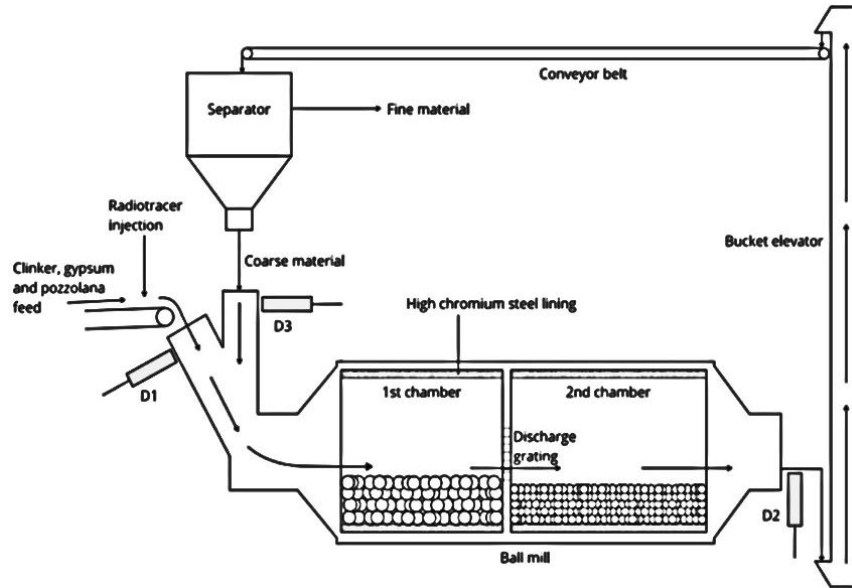


- **Throughput Maximised**
- **Reduced Energy consumption**
- **Quality preserved**

# Horizontal Finishing Mill Optimization

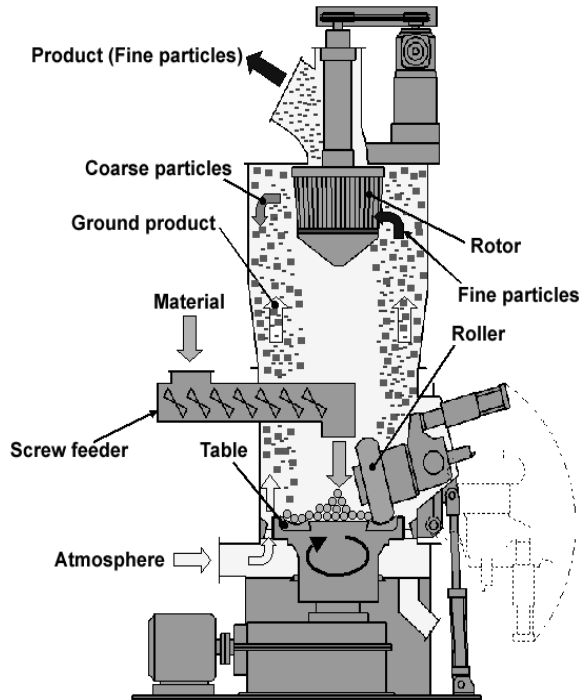
## Typical achievable improvements

Finishing Mill		
Throughput	5% to 10%	increase
Energy	3% to 10%	saving
Blaine	up to 90%	In range increase
Passing	up to 100%	In range increase



- Production
- Blaine
- Passing
- Energy consumption

# Vertical Raw Mill Optimization



- **Production**
- **Humidity**
- **Fineness**
- **Energy consumption**

## Typical achievable improvements

Raw Mill		
Throughput	2% to 9%	increase
Energy	5% to 10%	saving
Fineness	3% to 6%	improvement

# OPTIMITIVE

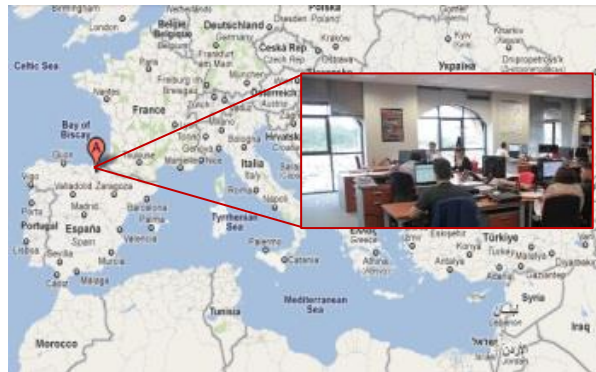
Founded in 2008.

Patented technology.

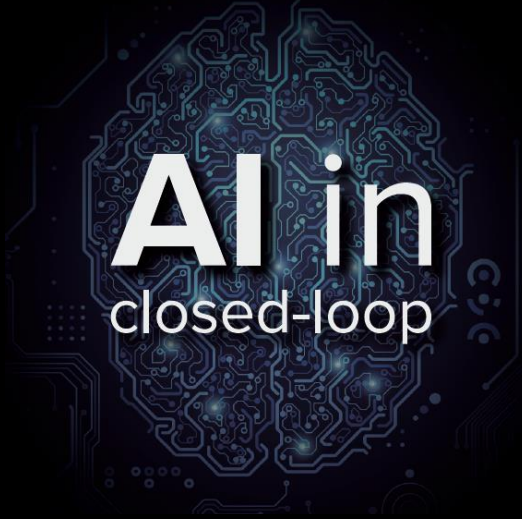
Specialists in AI in closed-loop and open-loop.

Spain, Luxembourg, Germany.

Operating in 3 continents.







**Optimal throughput  
and energy for Kiln and Mills**

More information:  
[market@optimitive.com](mailto:market@optimitive.com)