

Petuum Industrial AI

Higher efficiency, lower energy use for smarter, safer factories

Overview

Petuum Industrial AI creates outcomes beyond today's automation technology. It enables unprecedented yield and energy savings while reducing unplanned shutdowns and accidents. Petuum achieves these outcomes by learning the dynamics of industrial assets and processes from historical sensor data, creating prescriptions by searching for the optimal values of critical control parameters, and closing the loop by sending prescriptions back to assets and processes to be activated. Petuum Industrial AI seamlessly transforms traditional factories into smart factories. To our customers, "Petuum Industrial AI is like having a golden day of operations, repeated and sustained every day".

Key Benefits



Increase Productivity

Increase Yield

Improve yield by correcting, fine-tuning and stabilizing process variables, such as temperature, pressure, electric current, flow rate, gas levels and more, to provide a more efficient and effective operational environment. Petuum AI consistently stabilizes process variables beyond what today's automation systems are capable of.

Improve Product Quality and Consistency

Minimize process and production inconsistency in real-time by constantly re-learning and adjusting system dynamics and control mechanisms, even under changing operating conditions such as weather, wear and tear, and operators' preferences. By deploying Petuum AI across multiple sites, businesses can achieve organization-wide standardized operations.

Reduce Product Giveaway

Avoid over-or-under production, poor quality yields, and energy inefficiency. Thanks to stabilized process variables, Petuum AI creates efficient and predictable factory yields.



Enhance Process Stability

Reduce Downtime

Prevent quality issues and operational downtime with predictive maintenance, smart alerts, and continuous monitoring of all operational components. Petuum AI prescriptions are smooth and gentle, reducing wear and tear by preventing sudden changes to process variables.

Improve Process Safety

Prevent accidents that may happen due to false assumptions or distractions with Petuum AI's prescriptions that adhere to safety constraints on process variables – e.g. temperatures cannot be too high or too low.

Increase Responsiveness

Rapidly detect and remediate issues in near real-time. Petuum AI prescriptions are sent back to assets and processes in a real-time closed loop providing timely response and alerting ahead of operators.



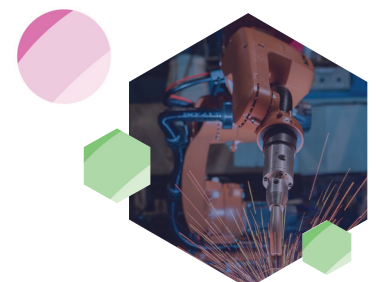
Improve Energy Efficiency

Cut Energy Consumption

Eliminate the need for large corrective actions by stabilizing process variables to a fine equilibrium with Petuum AI, lowering energy consumption and operating costs.

Reduce Environmental Emissions

Increase usage of alternative fuels with Petuum AI, further reducing associated costs and emissions.



Optimum Product Line

Industrial AI Optimum product line enables complex manufacturing operations to achieve higher optima – higher yields, lower energy use, reduced emissions, safer operations, and better maintenance frequency. Petuum Optimum can include important signals not supported by other systems, because of its AI architecture that continuously re-learns system dynamics from multiple data sources such as sensor streams, historical operations data, industrial video, thermal or microscopic imaging, acoustic recordings, vibration sensors, and enterprise data records. Optimum also incorporates safety constraints on key variables and can be run in a fully automatic closed-loop mode while under operator supervision.

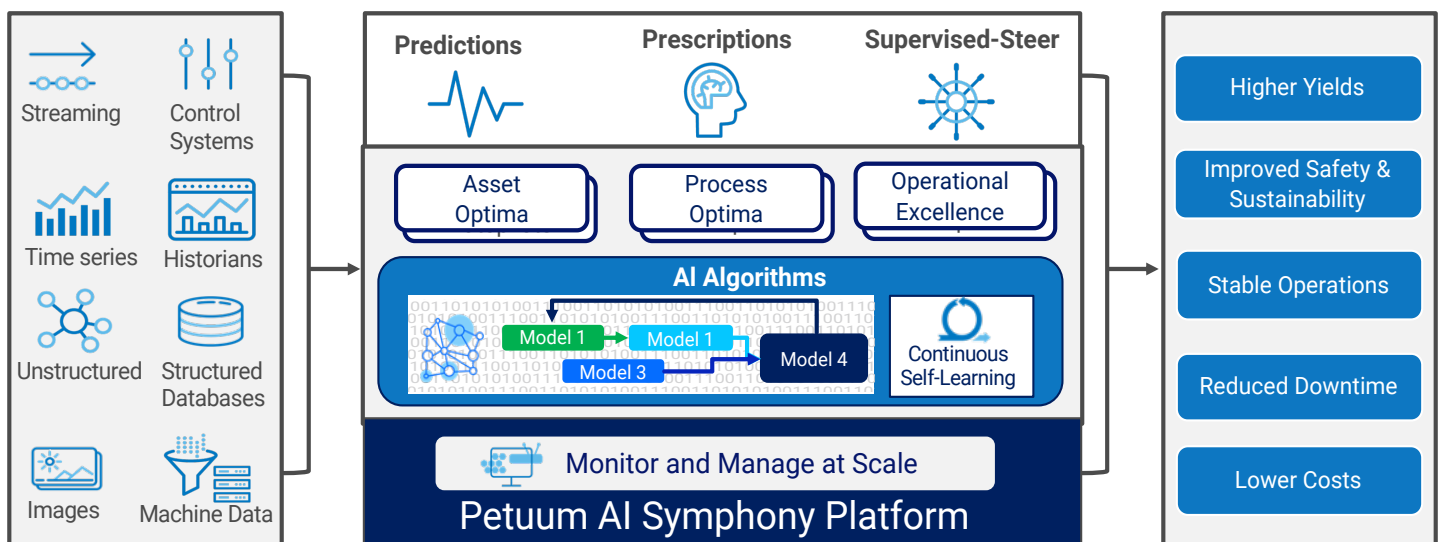
Petuum Optimum creates predictive models of process variables and asset states at multiple time resolutions, forecasting seconds, minutes, hours or days into the future and explores those predictive models to generate prescriptions for assets and processes. Through a supervised “autosteer” mode, these prescriptions are automatically activated, enabling smart and precise control of process variables that result in improved yields, lower energy usage, greater stability and more.

Delivered as a service or on-premise, Optimum is Petuum Industrial AI’s most cutting-edge line of products and includes modules for asset optima, process optima, and operational excellence initiatives.

“
Petuum Industrial AI [Optimum] helped us achieve something we didn’t think was possible at this time. We expect our yield improvements and energy savings to be up to 7%, from the connected AI-based AI-pilots, which is game changing for our industry. Additionally, this is a giant step in digital transformation towards safe, highly standardized operations, that will help us strengthen our high-quality products portfolio while also ensuring we meet our operational and sustainability goals, and minimize costs.”

 **Rodrigo Quintero**
Operations Digital Technologies Manager in Cemex

Petuum Industrial AI Optimum



Powered by Petuum's advanced AI Platform, expert-built ML/DL algorithms deliver precise predictions, optimal prescriptions and optional supervised-steer for assets, processes and operational excellence initiatives.

Features



Powerful Data Processing Capabilities

Cleans and transforms a large volume of noisy, incomplete, and erroneous sensor data in different modalities collected from a fleet of assets into standardized, complete, and AI-ready feature representations. The product suite digests and understands information from diverse sources like historical operating data, real-time sensor streams, industrial imaging and microphones, vibration sensors, and enterprise data systems. Petuum's preprocessing modules are able to identify and remove irrelevant and unneeded attributes from data to minimize their effect on the accuracy of predictive models.



Data-driven Optimal Control with Superb Performance

Automatically discovers the operational mechanisms of assets and processes from historical data, and performs real-time multi-objective multi-step optimal control. It is able to capture long-range temporal patterns in time-series data, high-order correlations between sensor variables, nonlinear relationships between control parameters and operational objectives, and subtle anomalies caused by sensor malfunctions. Petuum Industrial AI creates sophisticated prescriptions that fine-tune all available controls simultaneously, enabling better results and resilience beyond human specialists and automation systems.



Continuous Learning and Improvement

Perpetually and adaptively re-trains and improves AI models by digesting online streaming data, discovering and assimilating unseen patterns from new data. This powerful capability allows it to adapt to changing operating conditions such as asset wear and tear, maintenance events, weather and environment changes, change in fuel mix and more. The Petuum software also provides intuitive explanations of the prescription outcomes to increase transparency and build trust with human experts.



Seamless Integration with Major IoT Ecosystems

Petuum Industrial AI directly plugs into data historians including OSIsoft PI System, Microsoft Azure IoT, and others where it is interoperable with data and functions therein. As a result, deployments can be completed in as little as three months. Delivering positive business outcomes much faster compared to one-off lengthy AI consulting efforts.



State-of-the-Art AI Architecture for Real World Problems

Petuum's world leading AI experts have infused years of recent, state-of-the-art R&D expertise to create an advanced AI architecture that combines multiple machine learning (ML) and deep learning (DL) models. Petuum's industrial AI architecture is a game-changing advancement over previous-generation analytics and predictive models, enabling closed-loop "autosteer" operation that was not possible before.

Working closely with domain subject matter experts enables us to train and fine-tune our AI architecture, achieving excellence on the most intricate industrial challenges. Unlike generic AI technologies, our dynamic AI architecture is continuously self-learning, allowing the system to constantly improve as more and more data enters the system to reinforce the learning.

Use Case

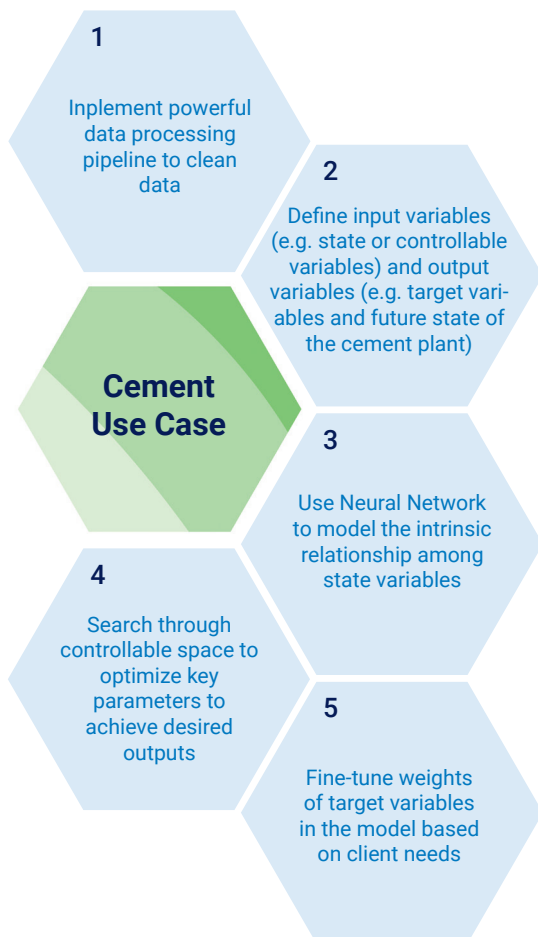
Petuum Industrial AI addresses many complex use cases. Let's explore deeper using one particular use case on 'heating and cooling optimization to increase yield.'

Many industries, including cement and metals, need to optimize heat in order to ensure the highest level of production while reducing wear-and-tear to the system. Furthermore, these industries are constantly looking for ways to reduce energy consumption as part of the production process.

Traditionally, these operational goals are achieved by manually adjusting the tunable parameters in a control system. Tens of thousands of sensors are installed on the large and complex manufacturing facilities to monitor their operational

status. Operators analyze the values of a limited subset of sensors and change the control parameters accordingly to optimize the operational goals. Due to the complex dynamics between the control parameters and goals, this tuning process is oftentimes ad-hoc, highly variable among different operators, less-effective, and time-consuming.

Petuum Industrial AI provides a data-driven optimal-control mechanism which automatically discovers the complex nonlinear dynamics between control parameters and operational objectives from a large volume of complex sensor data. Petuum effectively searches for the optimal parameters that yield the best objectives by solving a multi-objective constrained nonlinear optimization problem defined upon the learned dynamics. This solution is comprised of the following major steps detailed below.







The first component is data processing and representation learning. Petuum Industrial AI seamlessly connects to existing instrumentation, then ingests and cleans the vast amount of data from a diverse set of sources. Petuum's data processing pipeline is powered by a collection of transformation modules that perform missing value imputation, data normalization, feature selection, feature engineering and representation learning, which convert the original noisy, incomplete, erroneous, and irregular sensor data into readily actionable feature representations. (Step 1)

Given the AI-ready feature representation, Petuum Industrial AI learns nonlinear hierarchical models to capture the complex dynamics of the assets and processes, especially how the operational objectives change with the control parameters. These models effectively detect the long-range temporal patterns of the streaming sensor data, capture the high-order correlations between a large number of sensors, learn a hierarchy of low-level, middle-level, and high-level representations of the data, and discover the nonlinear and complex functional mapping from the control parameters to the objectives. (Step 2-3)

Once the operational dynamics are learned, Petuum Industrial AI performs effective multi-objective optimal control. It defines a constrained nonlinear mathematical optimization problem based on the learned dynamics and solves this problem to identify the optimal control parameters that yield the best objective values. Petuum collaborates closely with key subject matter experts to collect domain knowledge such as equipment safe operating range and peripheral environmental requirements and incorporates such knowledge into the optimization problems to ensure operational safety and productivity. (Step 4-5)

The deployment of Petuum Industrial AI solution is easy. The solution is now part of the closed-loop production system where it seamlessly fetches the sensor data and writes the prescribed parameters directly back to the existing control system without human intervention.

Petuum Industrial AI addresses key enterprise use cases to help enterprises solve real-world complex issues

Industry	Asset Optima	Process Optima	Operational Excellence
 Cement	Rotary Kilns, Coolers, Pre-heaters, Dryers	Pyro Process, Ball Mill, Vertical Mill, Horizontal Roller Mill	Fuel Mix Optimization, Emissions Reduction, Benchmarking, Kiln Campaign Extensions, Preventative Maintenance
 Metals	Furnaces, Crushers, Pots/Anodes, Hot Rollers	Blast Furnaces, Pot Rooms, Casthouse Smelting, Hall-Heroult, Acid Wash	Fuel Mix Optimization, Emissions Reduction, Health & Safety Control
 Mining	Drillers, Compressors, Turbines, Pumps	Remote Process Steering, Milling, Crushing	Energy & Water Consumption Management
 Chemicals Food & Beverage	Batch Reactors, Distillation Columns, Extruders, Compressors Pumps	Fermentation, Drying/Cooling, Catalytic Conversions, Grade Changes	Emissions Reduction, Quality Control, Benchmarking
 Oil & Gas Refining	Sulphur, Recovery, Distillation Columns, Cooling Tower, Coking, Hydrogen Unit, FCC	Crude Blending, Corrosion Control, Gas Consumption Forecasting	Emissions Reduction, Energy Usage Reduction, Prescriptive Maintenance
 Oil & Gas Upstream	Turbines, Drillers Compressors, ESPs, Well Simulation	Seismic Pattern Detection, Rock Type/Formation Forecasting	Fleet Management, Preventative Maintenance, Well Downtime Avoidance

About Petuum

Petuum provides innovative industry solutions with the most advanced artificial intelligence software, that has been out of reach for most businesses. Our products solve complex real-world challenges that traditional techniques have failed to solve, in a cost-effective, reliable, and simple-to-use manner. These are operationalized by world class AI experts and deep subject matter specialists, on top of the Petuum's Symphony platform, which delivers distributed and parallelized computing, large data processing, and machine learning and deep learning libraries at scale. Petuum makes machine learning and deep learning available as reliable, repeatable software that works for real problems.

Learn more about Petuum Industrial AI at www.petuum.com/products/industrial



Pittsburgh, PA
2555 Smallman Street, Suite 120 Pittsburgh, Pennsylvania 15222 USA

Sunnyvale, CA
150 Mathilda Place, Suite 650 Sunnyvale, California 94086 USA

business@petuum.com
Phone: 408.721.1137
www.petuum.com

