

CONTROL ON

AI-based Scientist Robot Operator for extreme predictive control in hyper-complex processing plants, networks or smart grids.



TEAM



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MARKET/SOCIAL NEED

1. Complex Oil & Gas or Nuclear Plants, Water or fuel networks and energy grids need predictive control to be continuously operated with ultimate operational Reliability, Availability, minimum Maintenance costs and robust safety.
2. Digital Twins (DT) of Systems, Operator Training Systems (OTS) and Modelling Tools are under development to implement AI based- predictive control functions.
3. Fitting the Plant's complexity results crucial and an overwhelming challenge.

SOLUTION

1. A predictive control routine is developed based on reinforced Machine Learning techniques of a AI-based SCIENTIST ROBOT OPERATOR.
2. The routine is implemented is the System Simulation Software OTS synoptic of the Plant's Digital Twin.
3. The proof-of-concept of the predictive control routine has been hardware validated in a simple Plant Control Unit (a permeation devoted tests) and the challenge of complexity implementation of the routine at diverse Plant Units Parallel computing is a HPC (MareNostrum5 at BSC).

KEY INNOVATION & DIFFERENTIAL ASPECT

Our predictive control routine is based on SCIENTIST ROBOT OPERATOR. The programmed "learning routine" mimics physico-chemistry (i.e.: is a physical-chemist robot) from validated laboratory data corresponding to a Plant's Unitary Operation. This "learning" establish the criterion about NORMAL/ABNORMAL/INCIDENTAL events at real Plant Systems as the natural intelligence of a scientifically trained human operator (now a SCIENTIST ROBOT) does. The learning supporting the predictive control is implemented as a specific routine in a Plant Digital Twin that includes system modelling, monitor instrumentation and the supporting routine.

The approach is proof-of-concept demonstrated in a simple prototypical unit for a singular Unitary Operation. Extrapolation towards extreme levels of Plant's complexity is proven. Key algorithms (generating Intellectual Property Rights) have been developed. Top Quality Assurance required standards (e.g. for SIC-1, Nuclear Safety Impacting Components, ISO-17XXX) are targeted. The new supporting predictive control routine linked into the Digital Twin permits "in-operando" continuous and dynamic control of the hyper complex Plants and Systems. Today, the "static" control approach are strongly conservative and limits system's operational availability (forcing stopping operation time-to-time), safety (delaying detection of failure events) and exploitation costs (maintenance, fuel losses,...etc).

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PROOF-OF-CONCEPT & PROTOTYPING

Hardware proof-of-concept prototypical demonstration provided for a simple control Unit (pipe inside glove-box atmosphere) corresponding to a singular Plant Unitary Operation (permeation).

ITER project qualified data is used for Scientist Robot Learning.

Extrapolation schemes to hyper-plant complexity provided based on parallel the solution at HPC (MareNostrum5 at BSC).

DEVELOPMENT STAGE

ITER Tritium Plant Hyper-complex Mass balance matching box topology. [ESTABLISHED]

- Four Plant Unitary Operation identified [ESTABLISHED]
- The quantitative control target [ESTABLISHED]
- ITER PLANT Digital Twin Synoptic Interface [ESTABLISHED AI4ALL]
- Selected singular Unit DEMO Full Digital Twin [ESTABLISHED AI4ALL]
- SCIENTIST ROBOT MACHINE OPERATOR learning from laboratory and data and support to Singular Unit Plant Control [demonstrated AI4ALL]
- Extrapolation to hyper-complexity enounced and proven; complete demonstration needed as a final and mature product development [beyond AI4ALL].

IP RIGHTS MANAGEMENT

Act for CONTROL_ON® in Notary Public (April.2021)

Model of Utility: Scientific Robot Operator routine

BCN_ATOMICS® Registered (R° P y M)

CONTROL_ON® Commercial Name registered. www.bcnatomics (/*.cat; /*.es; /*.eu, /*.com domain.

MARKET AND COMPETITORS

- **DIRECT APPLICATION MARKET:** ITER Tritium Plants, Other Nuclear Fusion Plants (DEMO, EAST, SPARC, ..), Hydrogen Production Plants. [size MM€, source: Frost & Sullivan, Market & Research)]. 5y potential business trends: > 0,1 % of MM€.
- **MARKET BY USERS:** Plant Owners, designers and operators, System Modelling Software developer companies (ASPENTECH, HONEYWELL, EEAA, TECNATOM), Services & Eng. Control Companies (PROCONSYSTEMS, INPROCESS,..), Singular Plants, Networks and grids in the world. [size MM€, source: Frost&Sullivan, Market&Research)] 5y potential business trends: > 0,1 % of MM€.
- **MARKET BY SECTORS:** Petrochemical (Oil&Gas), Hydrogen, Nuclear, Water/Energy/Traffic Network flows, Smart Grids, etc. [size MM€, source: Frost&Sullivan, Market&Research)] 5y potential business trends: > 0,1 % of MM€.

Competitors

- Other laboratories (KIT/TLK Karlsruhe, JET/UK, ...other,), research groups or spin-offs having similar knowledge and able to develop our routine.
- Software, control or specialized service companies (HoneyWell, ASPENTECH, INPROCESS, EEAA, KYNETRICS).

FINANCIAL PLANS (BRL: 2/3)

- Minimum needs.
- Manpower on a free collaborative base (but contractual) up to mature sealable product demonstration.
- Social capital of BCN_ATOMICS® created as in-kind Limited Liability Society (3150 €) plus intangible assessed value (AI4ALL Proof of Concept and Prototype hardware demonstration; 50 k€.
- Final saleable product minimum development cost in 1 year of time at negligible risk: [35 k€] = software licenses + CPU HPC time + 5 lab.tops
- Assessed rough value of this product ("8 x").
- Financial roadmap. Intends of: F4E R&D Grant, ENISA Loan 2021, NEOTEC CDTI 2022,.. with PROs/CONTs (under analysis).

ROADMAP TOWARDS MARKET

- Proof-of-concept and prototypical DEMO (as AI4ALL achievement , March 2021).
- Users feed-back (identified companies, F4E ITER) and identified external technical advisory (April-May 2021).
- Direct costumers contact (May-July 2021).
- BCN_ATOMICS® company constitution, registration, undertaking (July/August 2021).
- Financial Plans and Funding Undertakings (ACCIÓ, CDTI, F4E/ITER, other).

COLLABORATIONS AND ALLIANCES

