Multiverse Computing

IPZS & AGID Innovation Procurement: Anti-counterfeiting solutions based on artificial vision techniques

About us:

Founded in 2019, Multiverse Computing is the leading European software developer in quantum and quantum-inspired solutions.

Multiverse collaborates with prominent players in various sectors including finance, manufacturing, aerospace, defense and cybersecurity.

We leverage the combined power of AI and Machine Learning using our **patented** tensor networks technology to tailor our algorithms and software solutions to address industrial use-case challenges provided by our clients.

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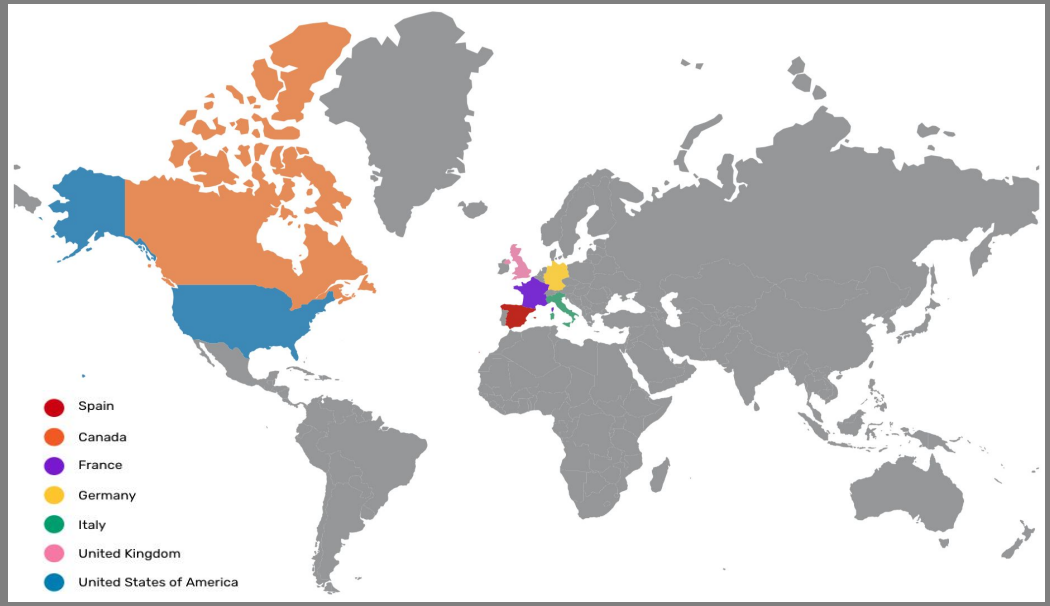
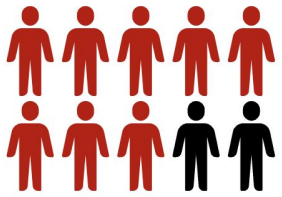
Worldwide Presence





+20%
Women

+50
Patents

20% PhDs

+30
Nationalities

+9.000
Citations

+100
Employees

+20 Scientific
Articles

BUSINESS VERTICALS

HEALTH & LIFE SCIENCES

Leveraging advanced AI systems for patient diagnosis, evolution, management of connected ICUs, and developing new AI simulation algorithms for drug discovery.

FINANCE

We develop quantum solutions to build a more resilient economy, faster and more accurate derivatives pricing and hedging solutions, better asset allocation, AI-based trading strategies, helping our customers earn more money while avoiding future financial crises.

DEFENSE

Implementing quantum and quantum-inspired technologies for predictive maintenance of critical infrastructures and deploying advanced AI security systems for a safer future.

CYBERSECURITY

Spanning from AI-based Adversarial-generated Threat Intelligence, to security testing against cyberattacks of symmetric-key encryption schemes, and evaluating post-quantum cryptographic protocols.

AEROSPACE

Leveraging a network of global quantum computers, alongside space and balloon-based quantum-inspired AI image processing, to drive ultra-efficient algorithms capable of tackling the most complex and demanding aerospace simulations.

ENERGY

Working on quantum-powered methods for cleaner energy production and distribution, more efficient batteries allocation, faster and more accurate weather-based forecasting, and sustainable market management, all for fighting climate change.

INDUSTRY

Creating future-ready factories by harnessing the power of quantum and quantum-inspired technologies to enhance digital twins, optimize logistics, streamline scheduling, accelerate product development, and ensure quality control through state-of-the-art quantum machine vision.

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TECHNOLOGIES

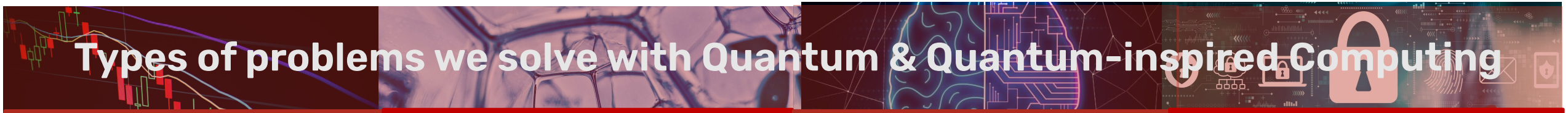
QUANTUM-INSPIRED

Platform-agnostic algorithms based on Quantum Computing principles running on conventional hardware systems.

QUANTUM

Algorithms based on Quantum Computing running on quantum hardware.

Types of problems we solve with Quantum & Quantum-inspired Computing



MACHINE VISION	SIMULATION	MACHINE LEARNING	CYBERSECURITY
-**Manufacturing:** Detect faulty products in a production line. -**Aerospace:** Autonomous satellite docking.	- **Aerospace:** Image simulation. - **Research:** Materials simulation.	- **Finance:** Fraud detection. - **Industry**: Predictive maintenance. - **Energy**: Market forecasting.	- **Cybersecurity:** anomaly detection - **Post-quantum cryptography**
Quantum inspired: Tensor Networks **CNN + Tensor:** Tensor Convolutional Neural Network	**Quantum**: IBM, Pasqal, IonQ, AQT **Quantum inspired**: Tensor Networks	**Quantum**: IBM, Dwave, Pasqal **Quantum inspired**: Tensor Networks	**Quantum**: IBM **Quantum inspired**: Tensor Networks

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Quantum technologies we use

IPZS Challenge
- RELEVANT USE CASES

MACHINE VISION: Quality Control

Binary classification of images of automotive parts with and without casting defects for quality control

PARTNERS - Ikerlan

PROBLEM TO SOLVE Identify the crack point and improve the training time and the inference/execution time of specific images.

MACHINE VISION: Space Docking

Machine Vision for Satellite Docking

PARTNERS AVS (Added Value Solutions)

PROBLEM TO SOLVE To develop a quantum computer vision solution for the optimization and support of the docking maneuvering process of satellites in orbit.

MACHINE LEARNING: Fraud Detection

Quantum Computing for tax fraud detection

PARTNERS - DIPUTACIÓN GIPUZKOA

PROBLEM TO SOLVE Detect when one company sends fake invoices to another one in order to get a VAT reduction.

CYBERSECURITY: Anomaly Detection

Quantum algorithm for anomaly detection in cyber-deception environments

PARTNERS - CounterCraft

PROBLEM TO SOLVE Early detection of cyber-attacks and monitoring of adversaries through quantum algorithms capable of highlighting, over the noise caused by the defense network itself, the events generated by the attacker.

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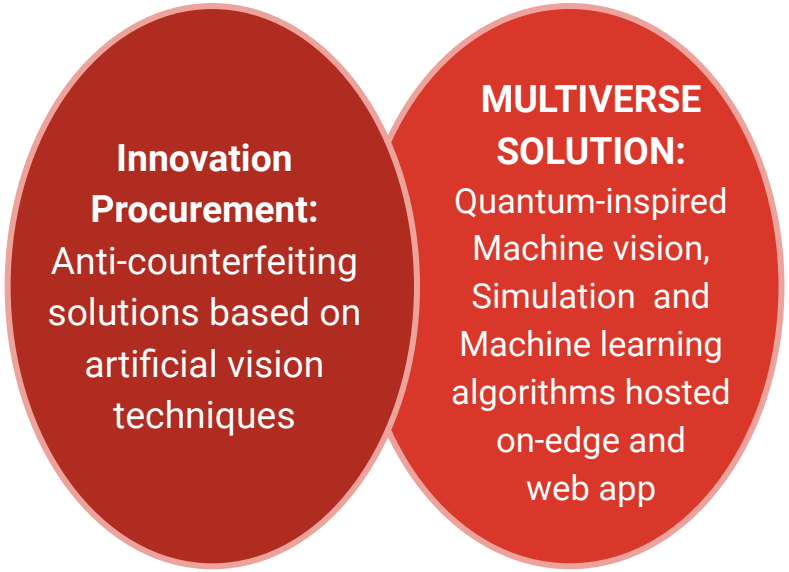
IPZS & Multiverse - Proposed project development implementation:



Phase 1 **DATA**: In collaboration with the IPZS team, the objective of this stage is to define the problem and how to evaluate the success of the implementation. Main activities to be carried out are:

- Define the dataset: Document the dataset, characteristics, and initial considerations.
- Data analysis: analyze and characterize the dataset through exploration.
- Feature engineering: Integrate auxiliary data considerations, record data preprocessing.
- Metrics: find the most relevant metric, in relation to KPIs.

Phase 2 **DEVELOPMENT**: The objective of this stage is to obtain and analyze the solution results for refinement and improvements.

- Build the solution pipeline: train the quantum-inspired model on the problem data and build all the necessary connections for a seamless model pipeline.
- Model optimization: define best model parameters for the problem at hand.
- Web application: front-end design and integration with model for user interface.
- Results: Analyze the results and propose improvements.
- Backtesting: Validate the resistance and quality of the solution in historicized scenarios.

Phase 3 **ENGINEERING:** The goal of this stage is to allocate and execute computing resources, as well as define computing environments to enable experimental replicability.

- Resource Allocation: allocate infrastructure and operational technology resources.
- Technical setup: create the technological environment to ensure replicability.
- Testing: users test deployed algorithms to validate execution reliability.
- Execution: inference tasks where models are used to predict from given unseen data in a production-like environment. These tasks involve applying learned knowledge or patterns to new, unseen data to make predictions, draw conclusions, or identify relationships.

PUBLICATIONS

- Tomut, A., Jahromi, S. S., Singh, S., Ishtiaq, F., Muñoz, C., Bajaj, P. S., ... & Orus, R. (2024). CompactifAI: Extreme Compression of Large Language Models using Quantum-Inspired Tensor Networks. arXiv preprint arXiv:2401.14109.
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- Bermejo, P., & Orus, R. (2022). Variational Quantum Continuous Optimization: a Cornerstone of Quantum Mathematical Analysis. arXiv preprint arXiv:2210.03136
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- Palmer, S., Karagiannis, K., Florence, A., Rodriguez, A., Orus, R., Naik, H., & Mugel, S. (2022). Financial index tracking via quantum computing with cardinality constraints. arXiv preprint arXiv:2208.11380.
- Orús, R. (2019). Tensor networks for complex quantum systems. Nature Reviews Physics, 1(9), 538-550.

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