

THREADED

Untangling Digital Thread - Enhancing Physics AI with Quantum Solvers

Quantum-inspired Physics AI boosts GPU utilization to
cut simulation costs

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The Digital Thread Promise Is Being Strangled

VISION: seamless, real-time physics simulations and AI-driven manufacturing connected end-to-end

The promise is clear. The execution is not.

- Digital Thread demands **continuous, real-time physics simulation**
- Physics-based AI is now central to:
 - Design optimization
 - Manufacturing control
 - Operational intelligence
- Yet workflows remain **batch-driven, siloed, and compute-bound**

Engineering demands have surpassed classical silicon's limits, requiring a new computing approach to meet AI-driven manufacturing's real-time needs.

The Utilization Crisis in Numbers

20%

Average GPU Utilization

For massive engineering and simulation workloads across major data centers

80%

Wasted Compute Capacity

Paid-for infrastructure sitting idle, burning capital without delivering value

\$Billions

Annual Compute Waste

Industry-wide cost of underutilized HPC infrastructure in engineering sectors

10X

Required Speedup

To make real-time digital twin workflows economically viable at scale

Why Physics AI Struggles at Scale

This is an optimization problem, not just an AI problem



- Physics AI depends on:
 - Large-scale, nonlinear, multimodal optimization
 - Coupled physics + data-driven objectives
- Classical solvers:
 - Scale poorly with design dimensionality
 - Collapse under real-world constraints
- Result: Slow convergence + massive compute waste

→ **Capital inefficiency** — organizations over-provision for peak loads that rarely occur

→ **Energy waste** — idle GPUs still consume significant power and cooling

→ **Diminishing returns** — each new hardware generation delivers less relative gain



Quantum-Inspired Algorithms: The Immediate On-Ramp

- Quantum-inspired optimization:
 - Mimics quantum behaviors (superposition, entanglement)
- Key advantages:
 - Massively parallel search
 - Escapes local minima
 - Hardware-efficient execution

No New Hardware

Deploys on current GPU/CPU infrastructure

Immediate ROI

Utilization jumps to 100% from day one

Quantum-Ready

Designed for near-term impact, not distant promises

From 20% to ~100% Utilization

Algorithm–hardware co-design unlocks dormant compute

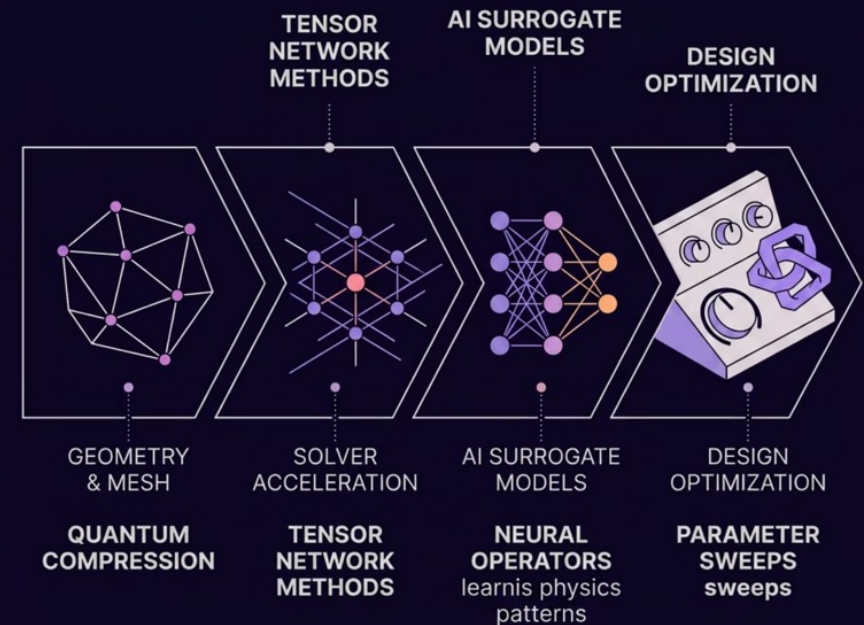
- Quantum-inspired kernels:
 - High arithmetic intensity
 - Sustained GPU occupancy
- Continuous parallel exploration instead of serial loops
- Result: :
 - Near-full GPU utilization
 - Dramatic throughput gains without new silicon

Quantum-inspired algorithms restructure how workloads are distributed and executed →
Eliminating idle cycles, compressing FLOPs, and enabling true parallel throughput across the
entire compute fabric

Quantum-Enhanced Physics AI

Where optimization and learning converge

- Tight coupling of:
 - Physics solvers
 - AI models
 - Global optimization
- Enables:
 - Faster training of physics-informed models
 - Real-time design space exploration
 - Live manufacturing feedback loops



Key Outcome: 10× faster simulations at lower cost

Aerospace Applications

Accelerating design under extreme constraints

Aerodynamic Shape Optimization

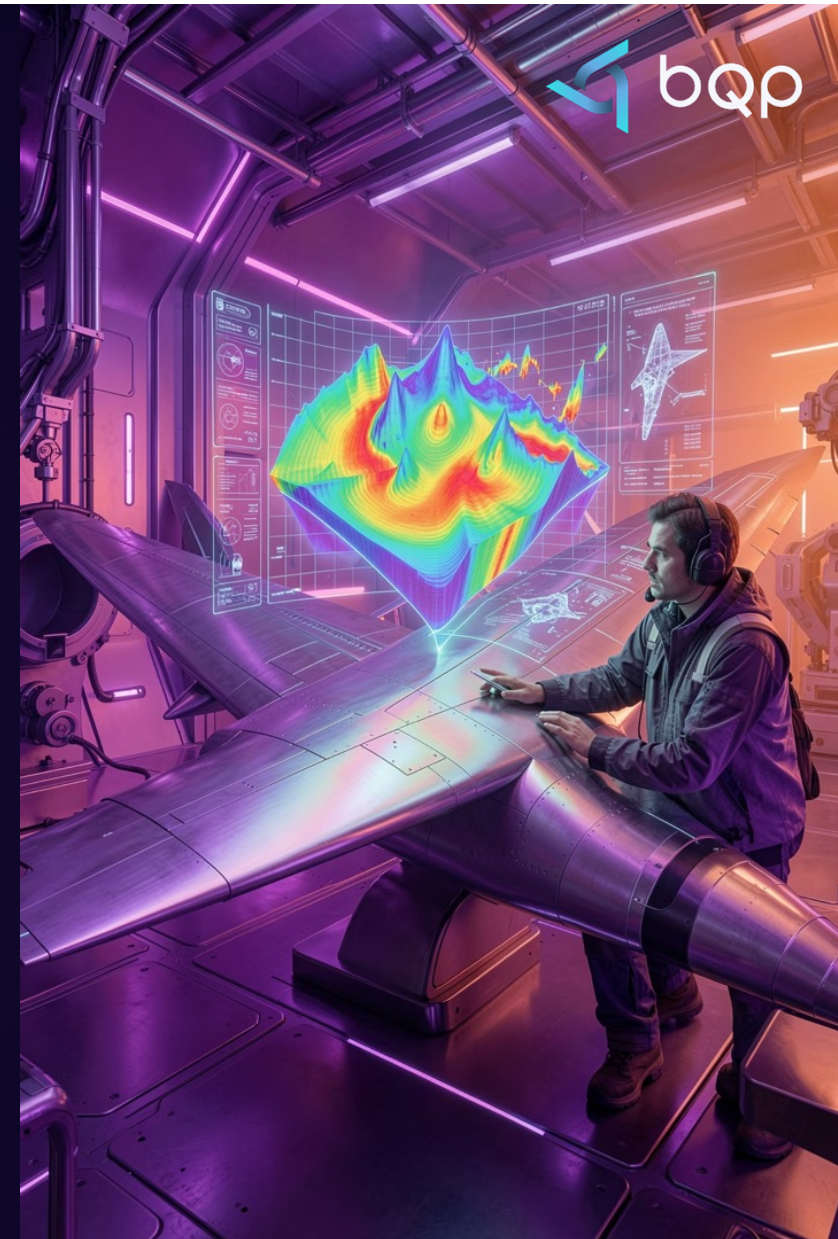
Maximize performance by accelerating the simulations, enabling engineers to explore 10x more design configurations per iteration cycle.

Structural & Thermal Simulation

Quantum-enhanced FEA reduces full-aircraft analysis from days to hours, enabling rapid design trade studies for next-gen platforms.

Digital Thread Integration

Real-time simulation feedback loops connect PLM, CAD, and manufacturing — closing the gap between design intent and production reality.





Semiconductor Manufacturing Use-Cases

Optimization at manufacturing cadence

Lithography OPC

Faster inverse lithography with quantum-optimized mask synthesis

Structural & Thermal Simulation

Full-chip thermal analysis in real-time for advanced packaging

Yield Optimization

AI-driven process windows that adapt dynamically to fab conditions



The Path Forward Starts Now

The quantum future of manufacturing isn't a decade away - **it's deployable today**. Quantum-inspired algorithms offer an immediate, hardware-compatible bridge to the full promise of the digital thread.

01

Assess Current Utilization

Identify GPU and HPC workloads with the highest idle capacity

02

Pilot Quantum-Inspired Solvers

Deploy on existing infrastructure → no new hardware required

03

Scale Physics AI Across the Thread

Extend to aerospace, semiconductor, and full digital twin workflows

04

Position for Quantum Hardware

Build the algorithmic foundation for tomorrow's quantum advantage



Thank You

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