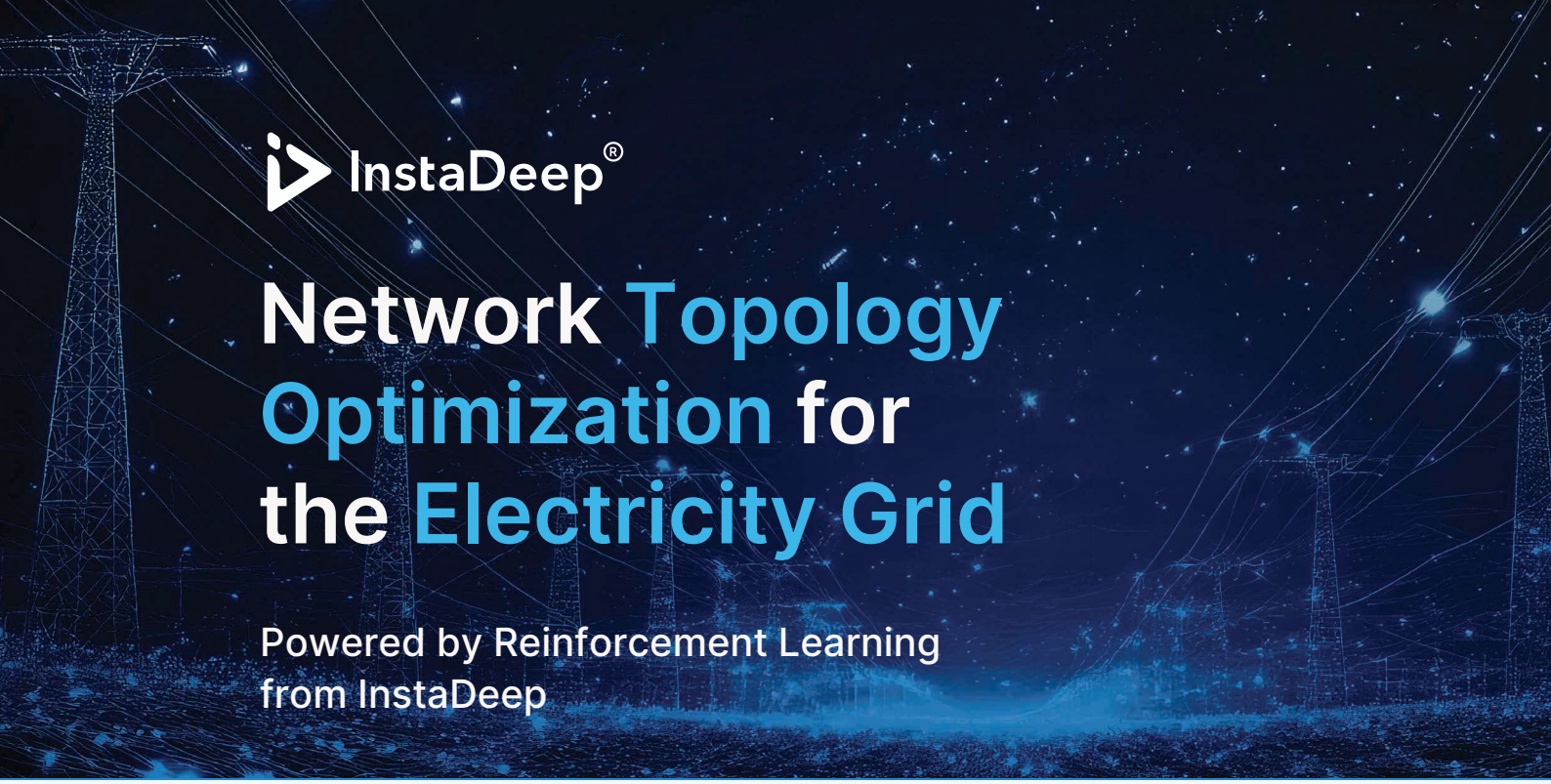

InstaDeep®

Network Topology Optimization for the Electricity Grid

Powered by Reinforcement Learning from InstaDeep

Energy Context

Europe's power grid is undergoing a historic transformation, integrating vast amounts of renewable energy while trying to maintain stability, resilience, and affordability.

Yet, this shift has come at a cost: grid congestion and redispatch measures have soared, with Germany alone spending over € 4 billion in 2022 to compensate for imbalances.

Traditional grid planning and simulation tools simply cannot keep up with the scale, variability, and speed required for modern electricity networks.

The Challenge

As renewable generation fluctuates and demand surges, bottlenecks across high-voltage networks force operators to curtail clean energy, triggering costly redispatch operations.

Current load flow simulators are too slow to explore the millions of possible network configurations needed for proactive congestion mitigation.

Without faster, smarter optimization, grid operators face unsustainable financial and operational strain.

Our Edge: Accelerated AI for Real-Time Grid Optimization

In collaboration with our partners Elia Group, InstaDeep has developed an AI-driven topology optimization framework that overcomes traditional computational barriers, enabling mass-scale simulation and informed decision-making.

- **GPU-Accelerated Load Flow Solver**: Executes >1 billion load flows per second using Nvidia H100 GPUs, over seven orders of magnitude faster than current tools.
- **Quality-Diversity (QD) Optimizer**: Extensible with Reinforcement Learning (RL) and rapid simulations, to generate and evaluate diverse grid reconfiguration strategies that reduce congestion.
- **Modular and Human-in-the-Loop design**: Provides control-room operators with on-demand AI modules that suggest and validate topology actions in real time.

Expected Added Value:

- **At least 10-20% congestion reduction** achieved through AI-based topology optimization.
- **> 200 million potential annual redispatch savings** for system operators.
- **30% overload** reduction observed in simulation, translating into higher grid reliability.
- **Scalable digital twin platform** enabling AI-based decision support for future control rooms.

Get in Touch

Explore how AI is reshaping the backbone of Europe's energy system, one decision at a time.

Discover how InstaDeep, along with its partner, is pioneering the AI-accelerated grid of the future.

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