LithoYield™ Stochastic Sensitivity Management
Phase Stabilization for Sub-3nm Optimization | CTO / R&D Brief

1. The Stochastic Wall

At sub-3nm nodes, Line Edge Roughness (LER) and local Critical Dimension (CD) variability are dominated by stochastic photon shot noise and chemical fluctuations. In this regime, conventional ILT / SMO pipelines frequently enter **non-convergent oscillation**, where additional compute no longer improves stability.

2. Approach: Geometric Phase Control

LithoYield™ introduces a **Geometric Control Operator** acting as a high-dimensional **Phase Governor** inside the optimization loop.
Key properties:

- Early detection of critical slowing-down
- Stabilization of inverse optimization under high stochastic stress

This layer does **not replace** Maxwell solvers or resist models; it governs optimization dynamics around them.

3. Algorithmic Yield (Definition & Validation)

Algorithmic convergence robustness is defined as:

$$Y_{\text{conv}} = \frac{N_{\text{stable}}}{N_{\text{total}}}$$

Validation performed via ensemble stochastic trajectories on distributed GPU-class infrastructure.

Node Regime	Baseline	LithoYield™
Advanced Node (Aggressive)	40–50%	**>75%**
High-NA / GAA Regime	35–45%	**>75%**

4. Integration Path (Zero-CapEx)

LithoYield™ is deployed as a **software-only control layer** compatible with existing OPC / ILT / SMO.
Sandbox metrics:

- Reduction of stochastic sensitivity gradients:

$$\frac{d(\text{LER})}{d(\text{dose})}, \quad \frac{d(\text{CD})}{d(\text{focus})}$$

- Stability across randomized perturbation seeds

No scanner modification or hardware requalification required.

5. System Integration Footprint

Pipeline Layer	LithoYield™ Interaction
SMO / ILT Solver	Phase-governed scheduling layer
OPC Engine	External supervisory control
Maxwell / Resist Models	Untouched (black-box compatible)
HPC Scheduler	Parallel stochastic orchestration
Fab Toolchain	No direct hardware interaction

6. Why This Matters at Advanced Nodes

- High-NA EUV reduces process margin
- GAA amplifies local CD sensitivity
- Optimization landscapes become highly non-convex
- Brute-force sampling increases cost without guaranteeing convergence

LithoYield™ addresses **optimization stability**, not physical model complexity.

7. Comparative Positioning

| Approach	Stability	Cost	Risk
Static Schedulers	Low	Low	None
Monte Carlo Oversampling	Medium	High	Medium
LithoYield™ Phase Control	**High**	**Low**	**Low**

8. Scope Boundary

This is: convergence stabilization for inverse lithography.
This is not: wafer-yield claim, scanner physics simulation, or resist chemistry replacement.
Specific operator discretization schemes and phase-coherence control parameters are available under restricted technical disclosure (NDA).

Algorithmic Convergence Robustness under Stochastic Stress
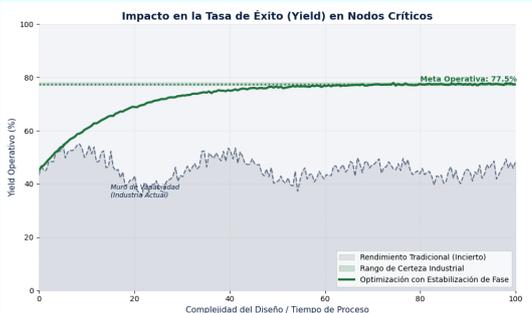
Interpretation:
Gray curve — Conventional optimization exhibiting oscillatory instability.
Green curve — Phase-stabilized trajectories converging under identical perturbation regime.
Dashed threshold — >75% convergence robustness.
Metric reflects algorithmic convergence stability, not physical wafer yield.

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Validated on distributed GPU-class architecture.
Industrial transfer protocol available under NDA.