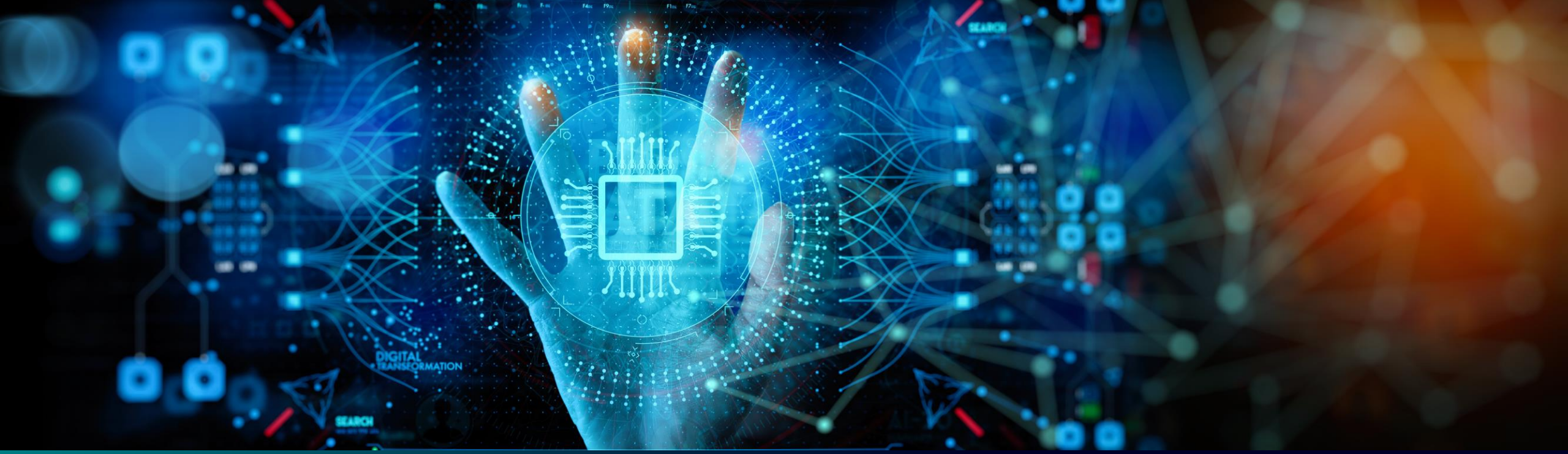

How AI is Changing Every Aspect of EDA, Starting from Transistor-Level Simulation

Sathishkumar Balasubramanian, Sr Dir & Head of products, Custom IC Division

Siemens EDA

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Society is demanding, and **depending on**, ever-increasing volumes of **semiconductor-enabled solutions**

Leading to

Semiconductor design volume is **ramping**

Semiconductor and system complexity is **exploding**

Semiconductor costs and schedules are **skyrocketing**

Universities are not graduating **enough engineers**

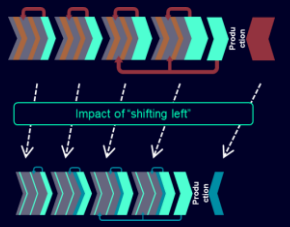
Existing talent is slowly **retiring or seeking other careers**

Requiring

Technology

Manufacturing aware design redefines limits

Process



End-product centric design through digital twins

Platform

AI supercharges engineering productivity

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The design productivity gap is a real and growing problem

1 Trillion

Transistors in chiplet based processors by 2030

How We'll Reach a 1 Trillion Transistor GPU - IEEE Spectrum

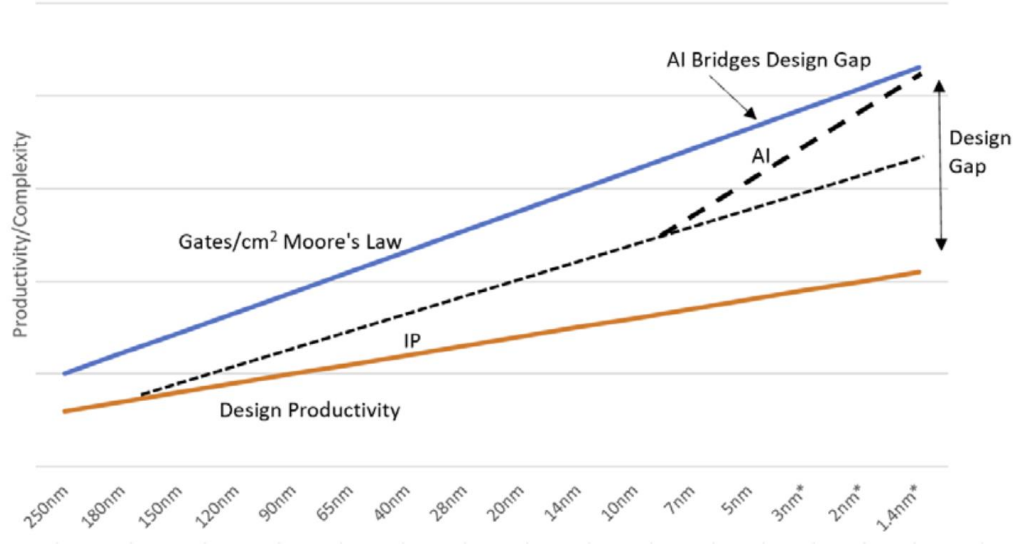
27.3K

Shortage of engineers in the US workforce by 2030

Shortage of Tech Workers - Semiconductor Industry Association (semiconductors.org)

The capability and complexity of a system is directly proportional to the number of transistors integrated into it

Figure 1: Altering the Design Productivity Gap



Advanced EDA tools, new methodologies such as "shift left", and SIP blocks (internal or 3rd party) have made it possible to close the gap somewhat … **IT'S NOT ENOUGH**

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Siemens EDA AI solutions delivering next generation productivity

AI-enabled platform to make better, faster, and more informed decisions

Platform

Technology

AI-embedded tools to deliver error-free designs

Processes

AI-automated to streamline end-to-end processes

AI based solutions drive organizational knowledge, collaboration and integration

AI for Chip Design Requires More Than Just Speedups…

Verifiability: Can you tell if the AI model is right?

Accuracy: How close to perfect is the AI model?

Generality: Does the AI approach work on everything?

Robustness: Can I bet my next design schedule on it?

Usability: Does it “just work” for my team?

AI CAD Tool Capability Levels

Level 0: No AI

Gives the right answer by running all cases. Often too compute-intensive for production use.

Level 1: Partially reliable AI

Big speedups. Sometimes right, sometimes wrong, and can’t tell. Cool demo! Shows promise. Not useful, yet.

Level 2: Partially reliable AI with accuracy-aware self-verification

Can tell when it’s right or wrong based on accuracy criteria. Tool can’t solve it automatically. Need a backup plan.

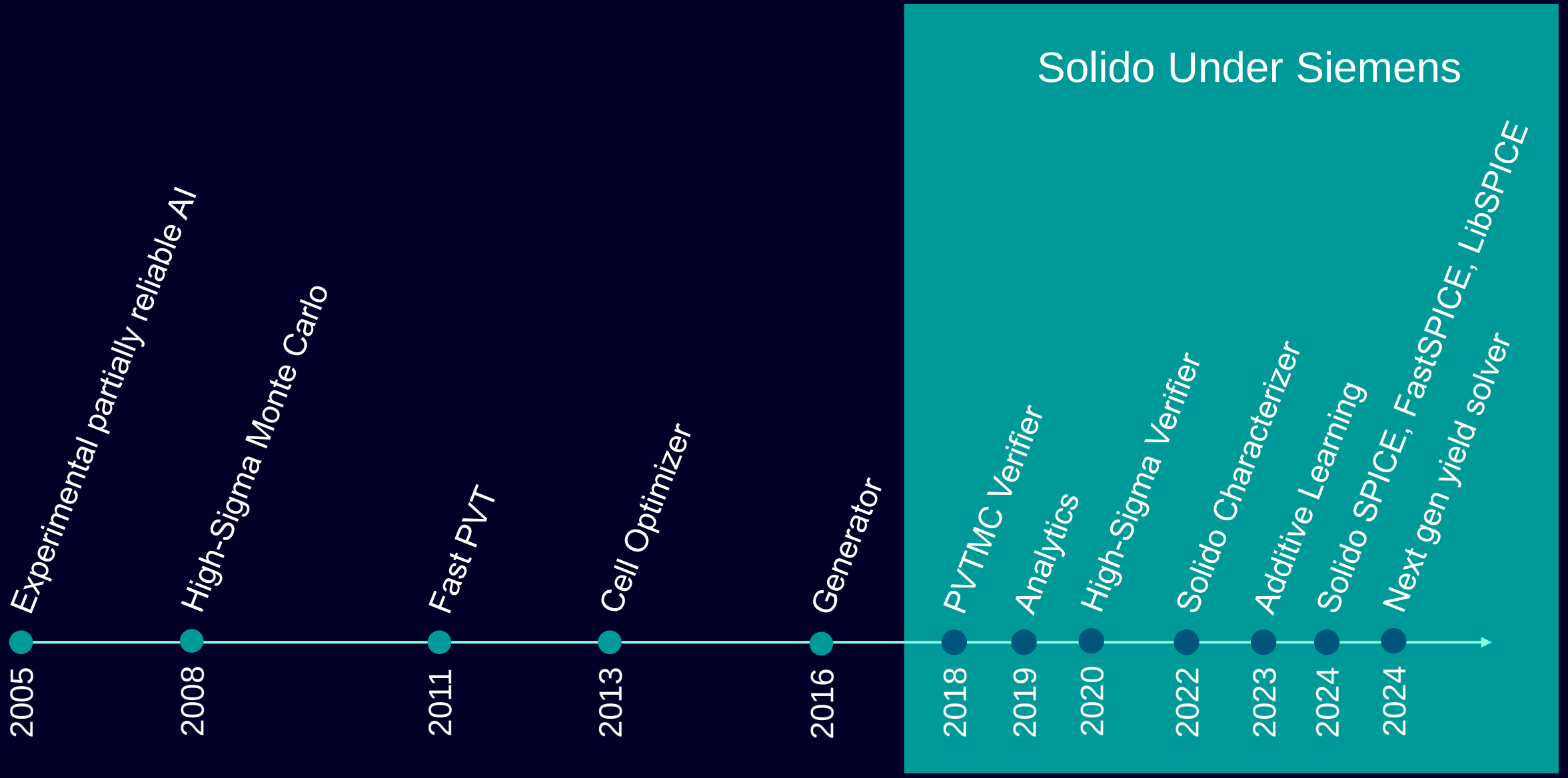
Level 3: Adaptive, accuracy-aware AI with self-verification

Meets accuracy criteria on most cases automatically. Still the odd bump. Useful, with great support.

Level 4: Fully reliable, accuracy-aware AI with self-verification

Production-ready and dependable. Production hardened and proven. Just works. Use it.

Solido AI Powered Tools Timeline



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Solido AI Powered Tools Timeline

Solido AI Powered Tools Timeline

2008: Solido High-Sigma Monte Carlo
Our first production-ready AI application for EDA

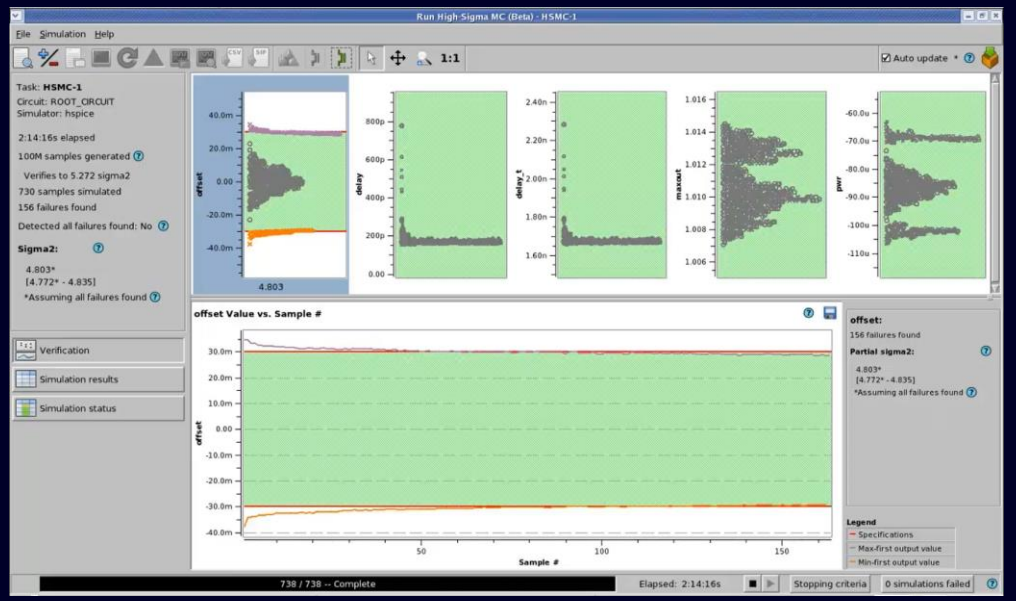
Fast: >1M X faster than brute-force MC

Accurate: Same accuracy as brute-force MC

Scalable: 100Ks of devices; 7+ sigma

Verifiable: Automatically verifies correctness and shows work

Usable: Learn to use in minutes, setup takes <1m



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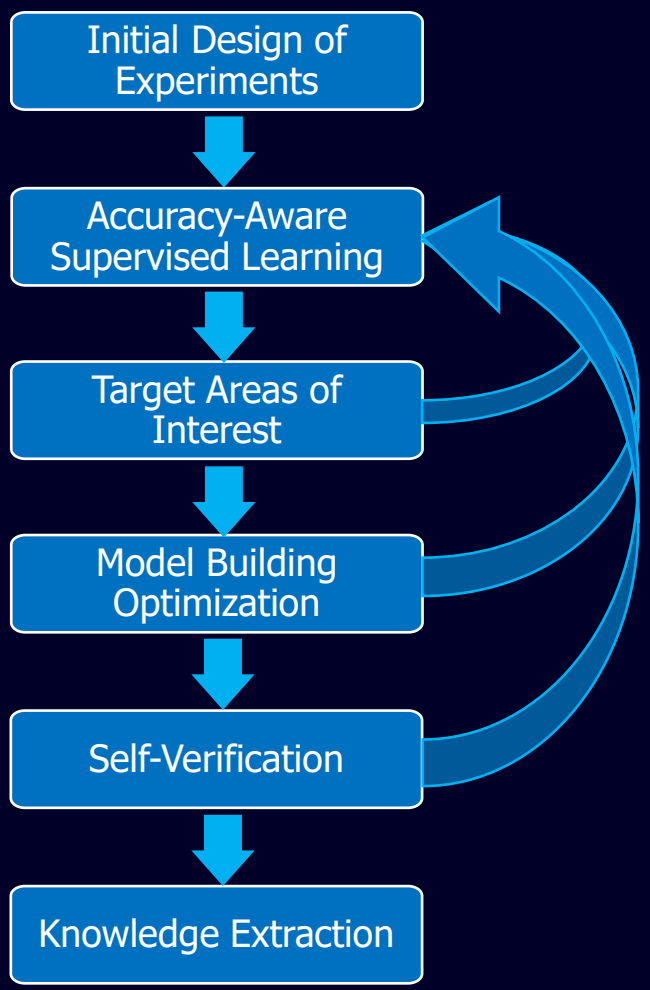
General Recipe for Solido-Style Adaptive AI



Start by simulating a small amount of the total space, equally spread and covering all main and interaction effects

Build an accuracy-aware ML model that can very quickly predict outcomes for the rest of the space

Use the predicted values to decide which cases are interesting and simulate those; get simulation accuracy where it matters

Make the rest of the predictions adequately accurate; run more simulations in areas of greatest uncertainty

Prove that the areas of interest are covered and that target accuracy is achieved throughout the space

Help with insight and debugging by revealing dominant terms in ML models

Solido AI Powered Tools Timeline

2011: Solido Fast PVT

Solido's 2nd level 3 AI tool for chip design

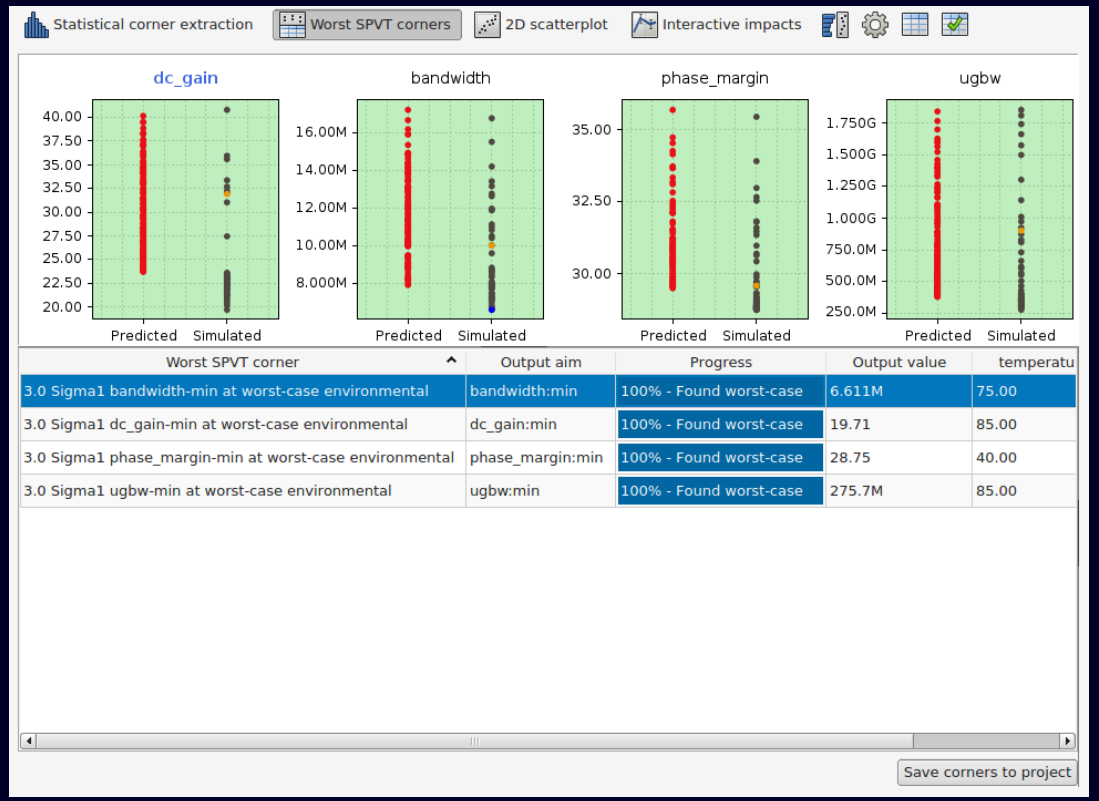
Fast: 2X-100X faster PVT analysis than brute-force

Accurate: Exact same accuracy as brute-force

Scalable: 1000s of corners, 100s of outputs

Verifiable: Automatically verifies correctness and shows work

Usable: Learn to use in minutes, setup takes <1m



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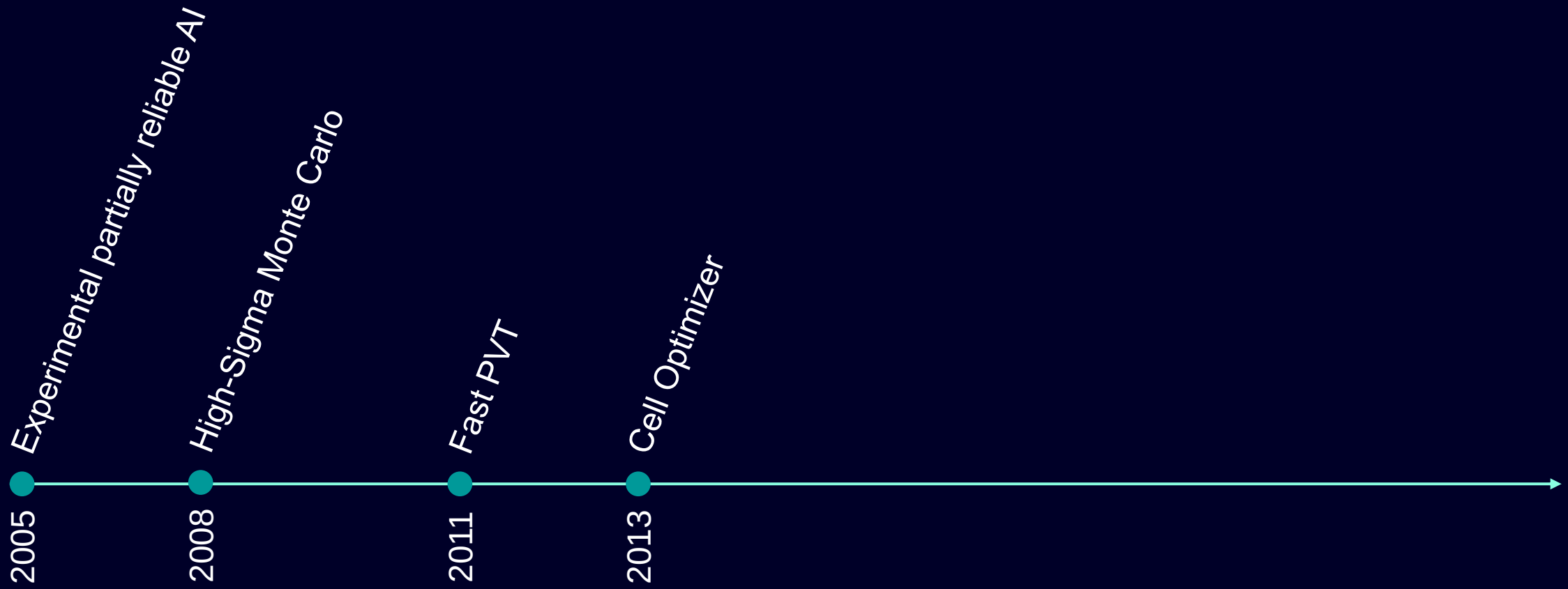
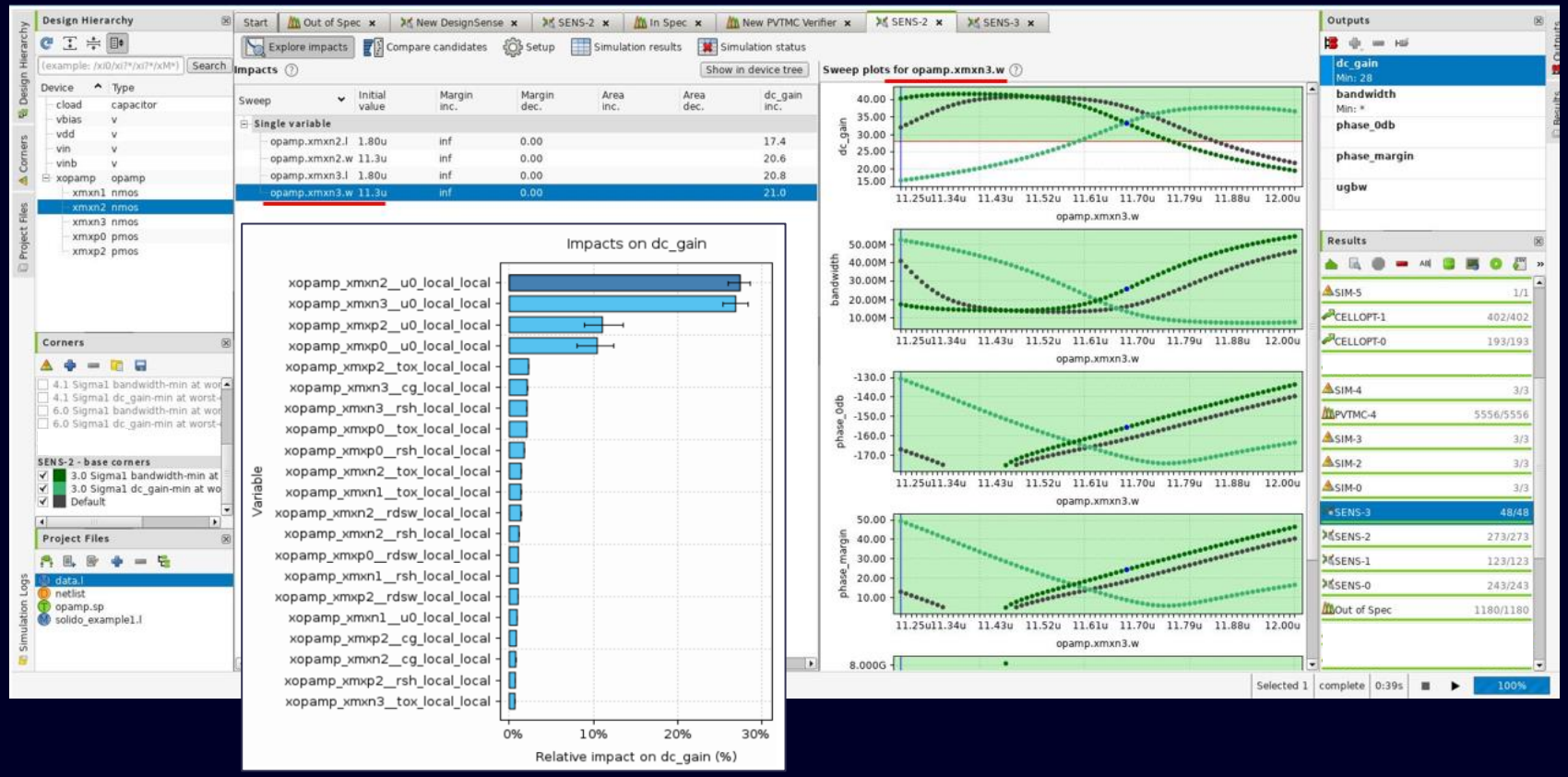
Solido AI Powered Tools Timeline



2013: Assistive AI Optimization Methods Reduce Iterations and Over-design

5X-10X productivity improvement with better quality of results

- **Identifies optimization paths** to improve PPA
- Determine **optimal sizing of devices** to achieve target PPA based on prioritized output
- **User-friendly reporting** and **visualization**



Saves days / weeks of engineering time with AI-assisted optimization

Solido AI Powered Tools Timeline

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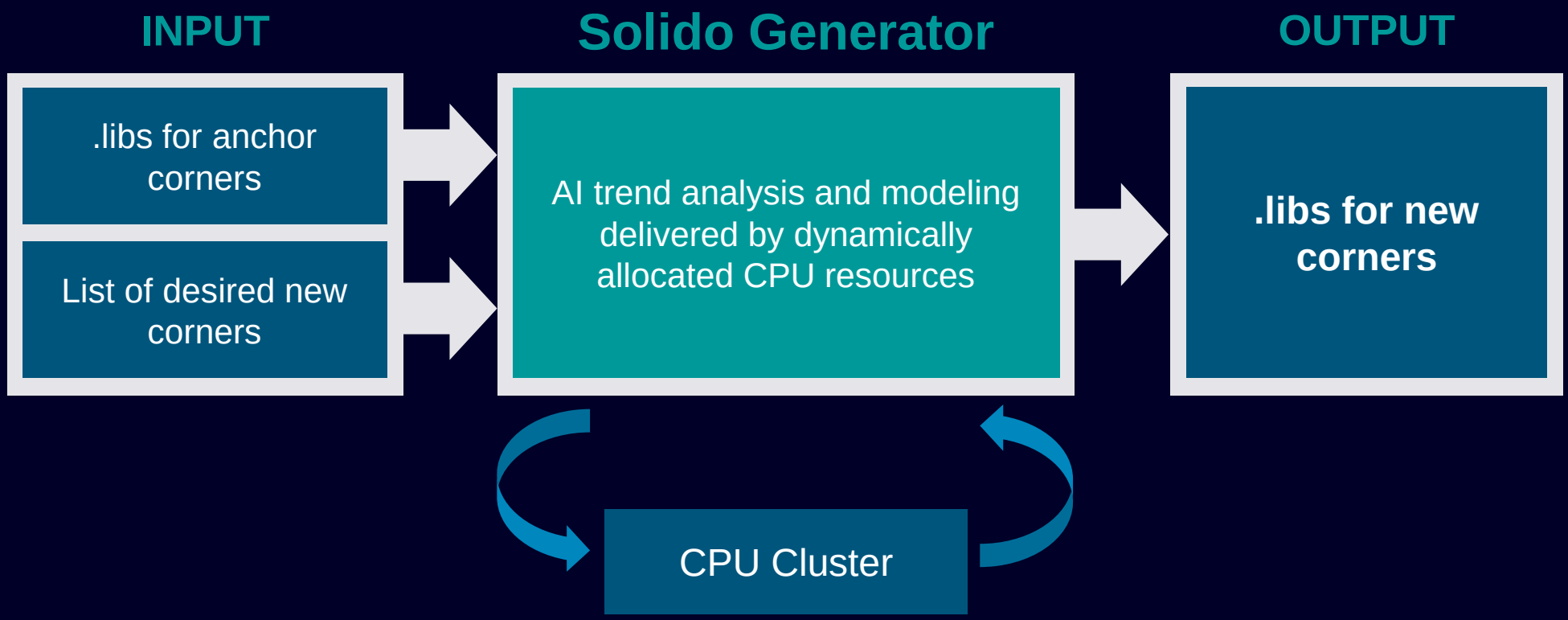
2016: Solido Generator
Accelerating .lib Production with AI



Generates new, production-accurate PVTs **100X+ faster than SPICE**

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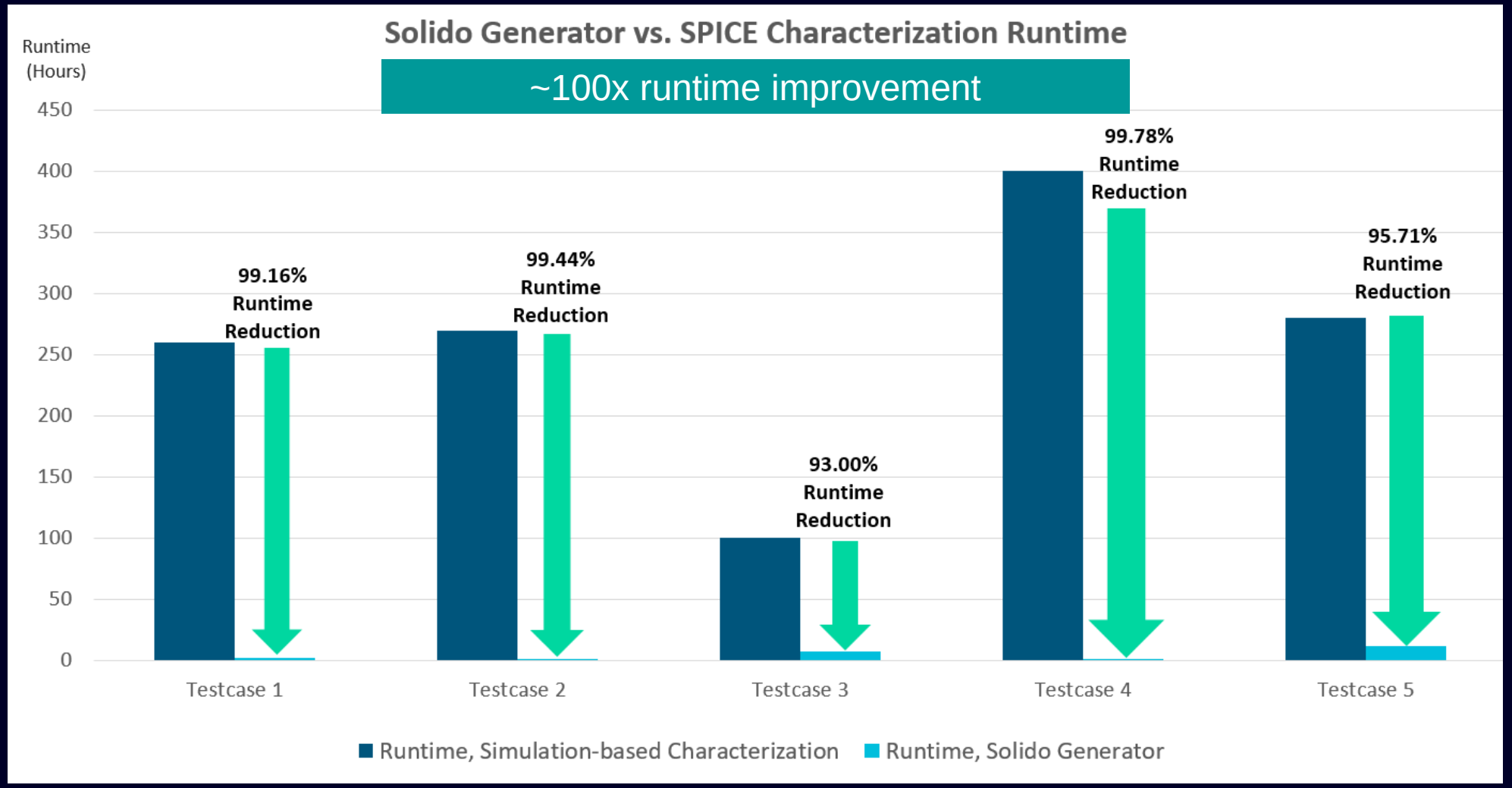
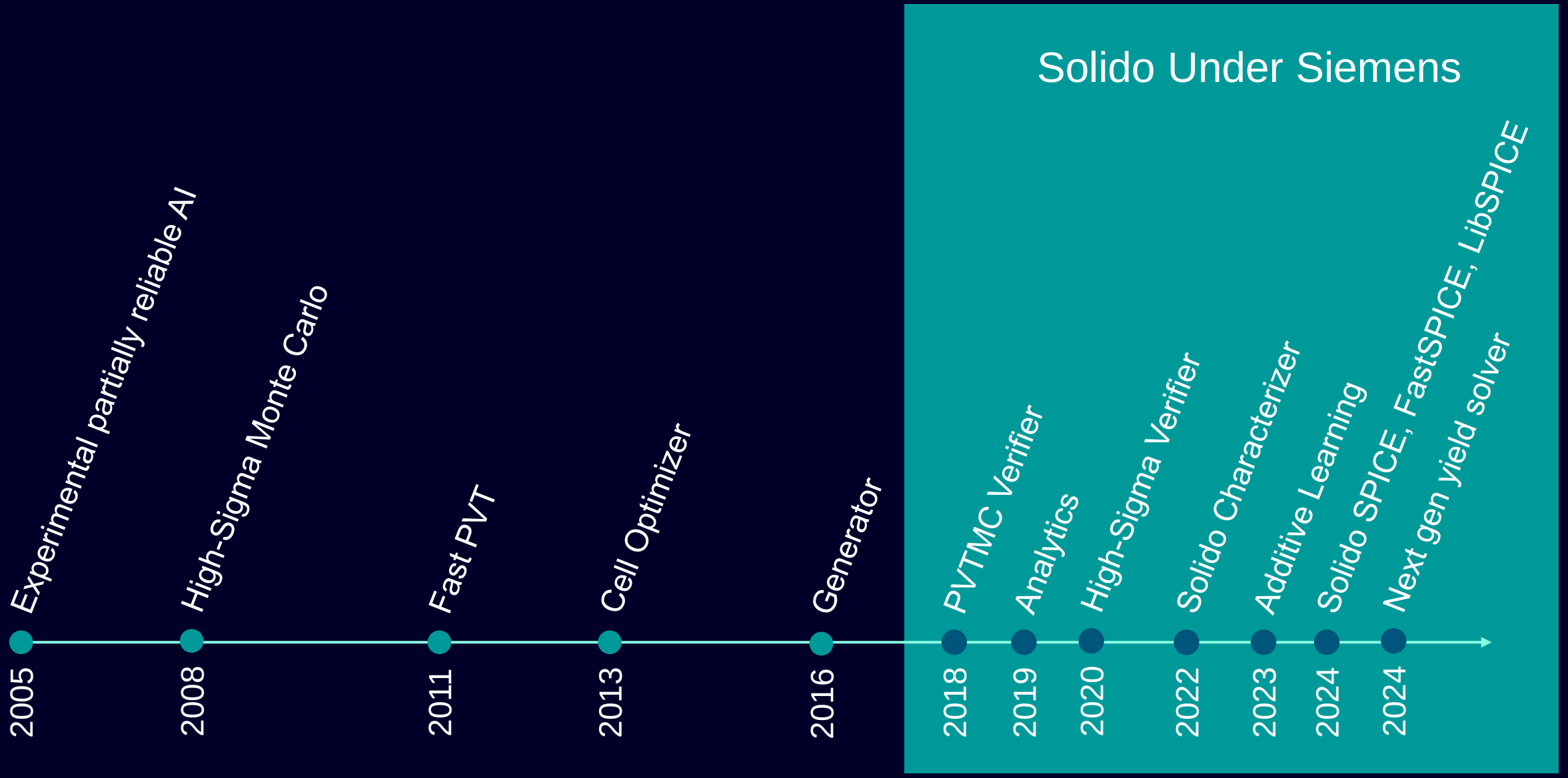
2016: Solido Generator
Runtime Speedup Results



Solido AI Powered Tools Timeline



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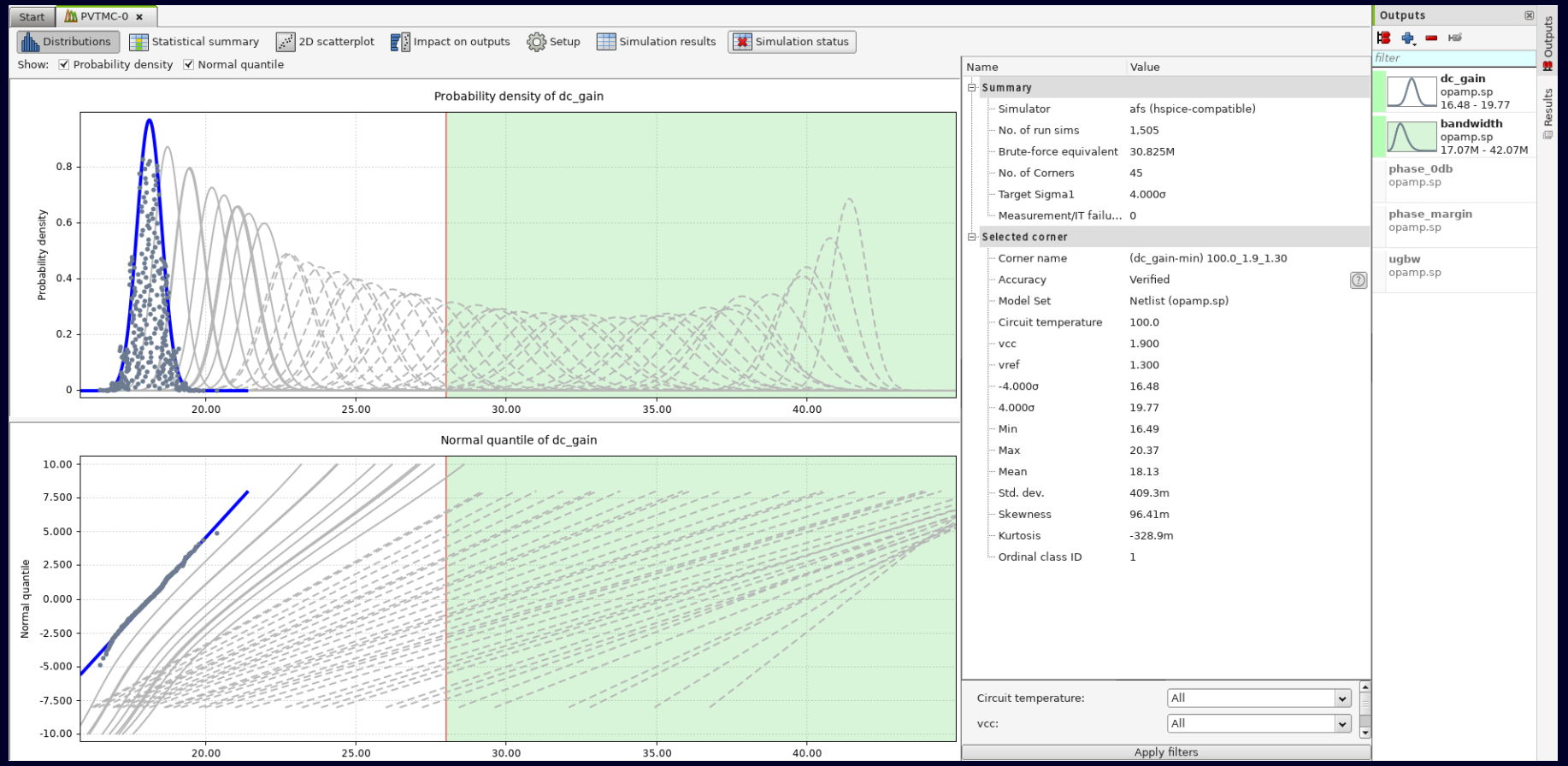
2018: Adaptive AI with Solido PVTMC Verifier
Example



- Full **4-sigma** verification across **45 PVTs**
- Verification equivalent to **30.825M** brute force simulations
- In only **1,505** simulations
- **20,000x+** speed-up

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2019: Solido Analytics
AI Outlier Detection

Automatically detects outliers/issues static rules will miss

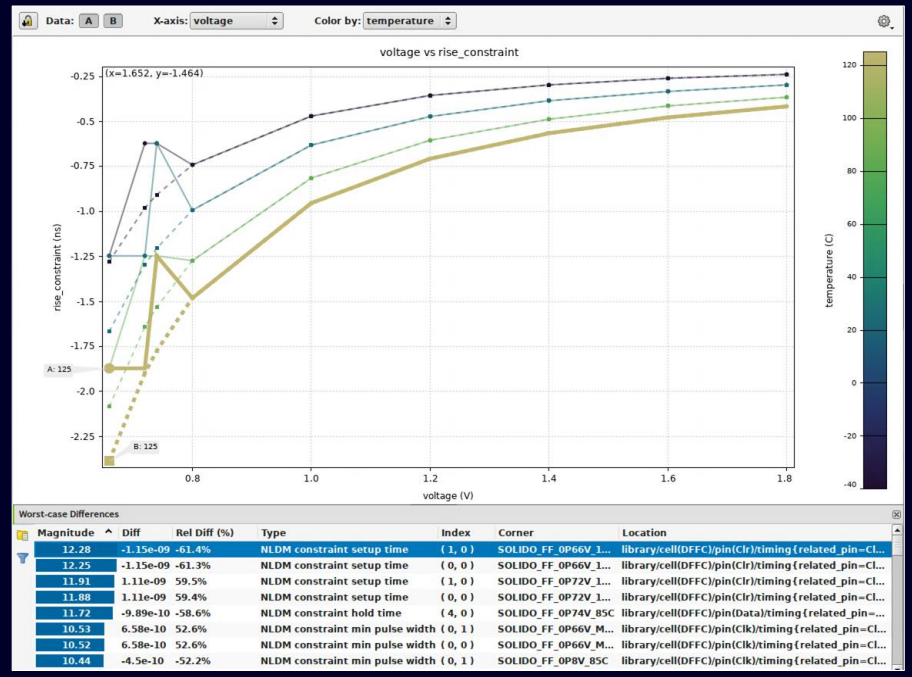
- Catches unexpected values in the trends across PVTs, and across measurement tables (slew/load, etc.)
- Does not require transistor models, SPICE netlists, or char setup

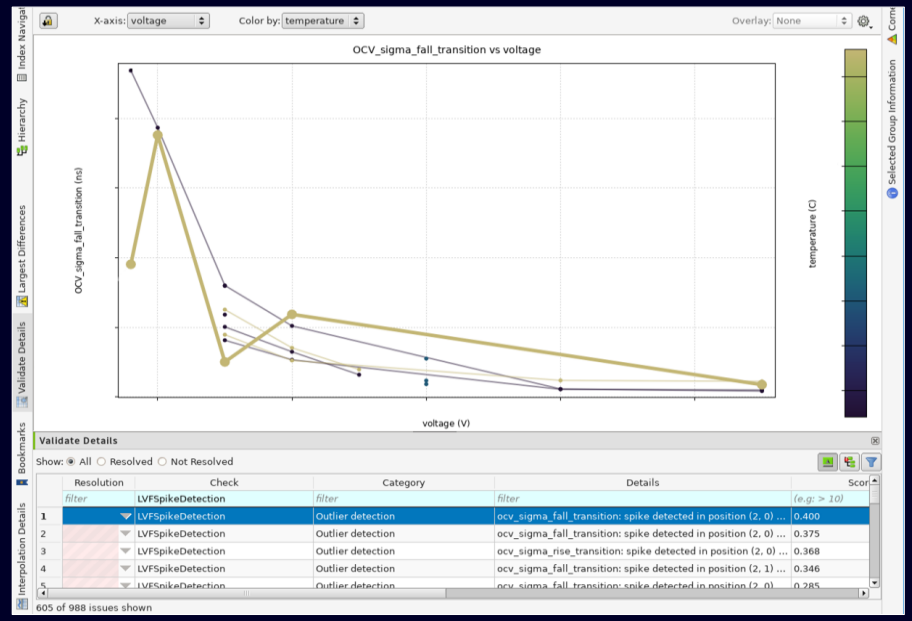
Runs in interactive or batch mode

- Summarizes and ranks the detected outliers, generates reports
- GUI visualizes outliers, helping diagnose the issue

Benefits

- Catches quality issues undetectable by other methods
- Does not require SPICE simulation





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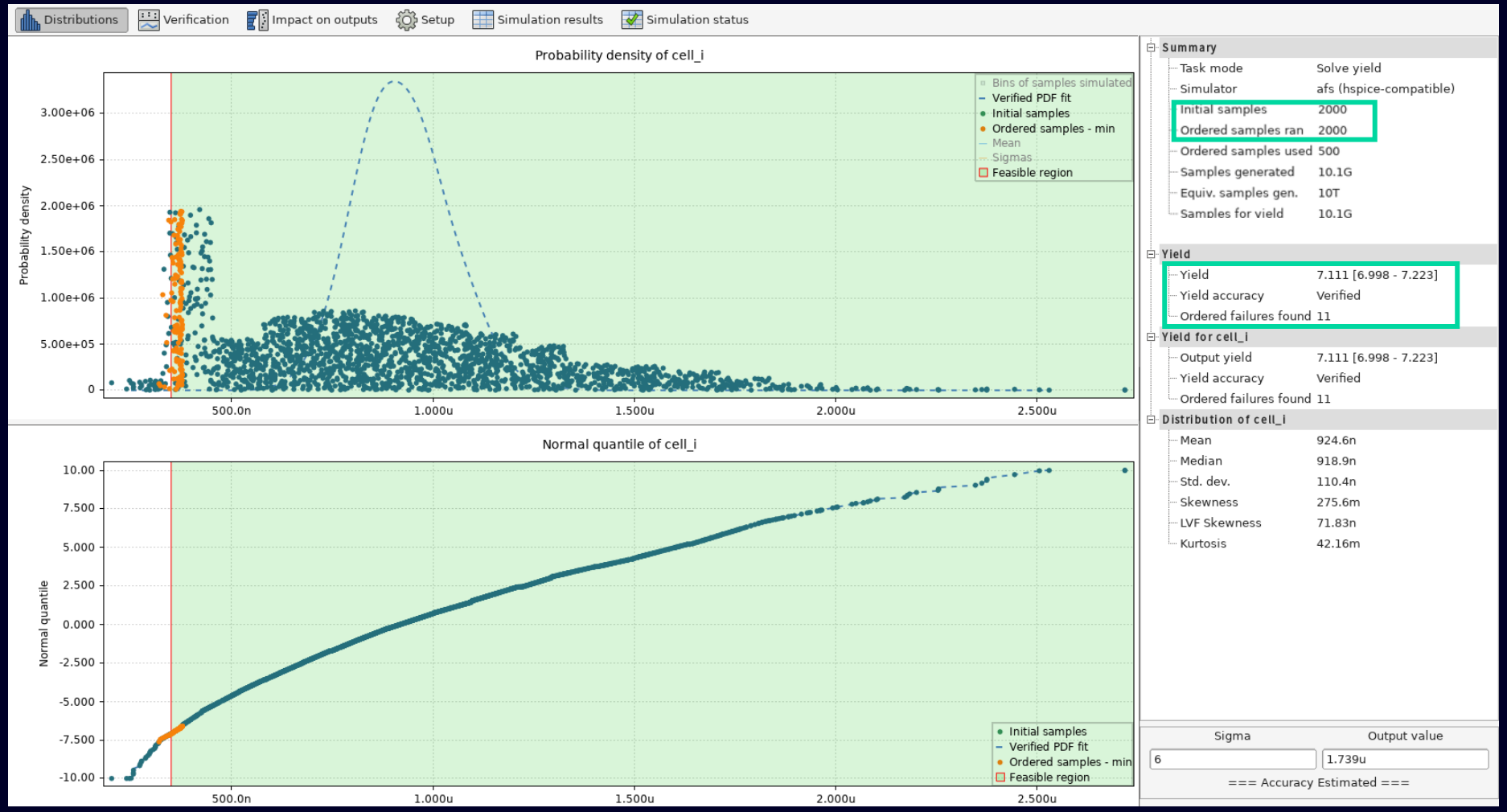
2020: Solido High-Sigma Verifier
Solido's next gen high sigma solver

- 7.1 sigma verification equivalent to **10 trillion** brute force simulations
- Only **4000** simulations
- Perfect Monte Carlo & SPICE accuracy
- **2,500,000,000x** faster



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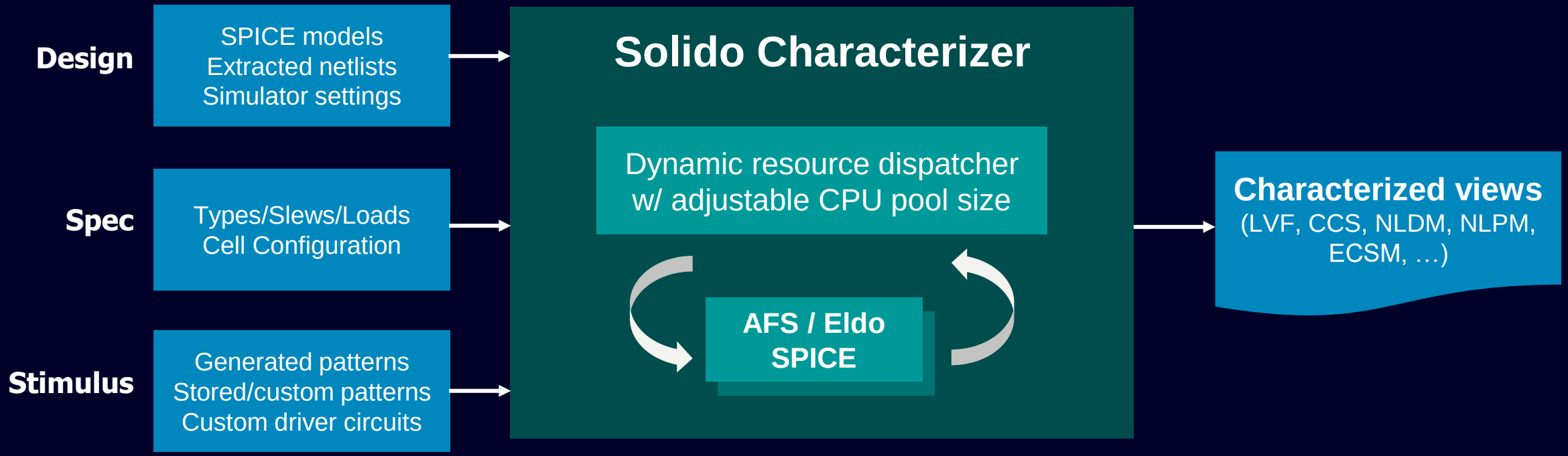
2022: Solido Characterizer

High performance, high-accuracy SPICE characterizer with adaptive AI

- **High performance, high accuracy** SPICE characterization
- **Solido LVF** reduces LVF runtime while dynamically boosting accuracy using Solido's leading variation AI tech
- **RL Engine** uses Solido Generator and Analytics AI technology to verifiably reduce LVF simulations



2023: Solido Additive Learning

Accelerates variation-aware design and verification in Solido DE by additional 10X-100X

Retains and reuses AI models from previous runs

Applies to incremental runs to speed up by 10X-100X (PDK updates, design iterations, …)

Automatically determines applicability, always gives the right answer

10X-100X speedup per iterative job

Weeks of schedule savings, immediate variation feedback on design-stage iterations

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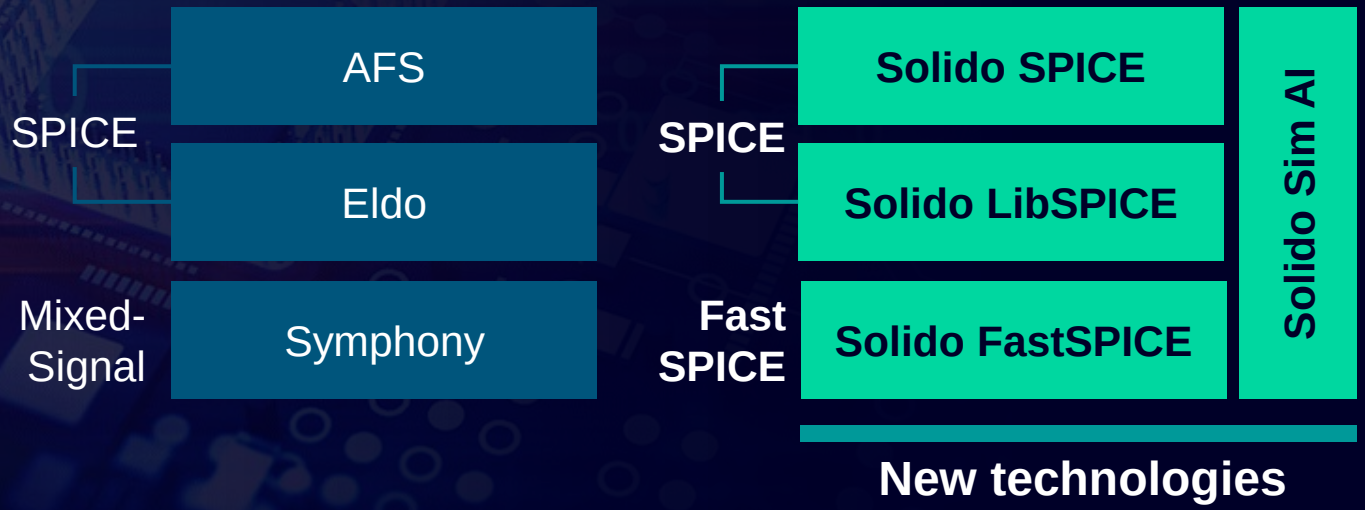
2024: Solido Sim: New AI Accelerated Simulation Suite

Faster and more accurate

Solido™ Simulation Suite

AI-accelerated simulators
for intelligent design and verification



Accurate, high performance with **order-of-magnitude speedups**

Unified SPICE, Fast SPICE, and library IP custom simulation

Integrated for custom IC signoff flows
Foundry PDK **certified**

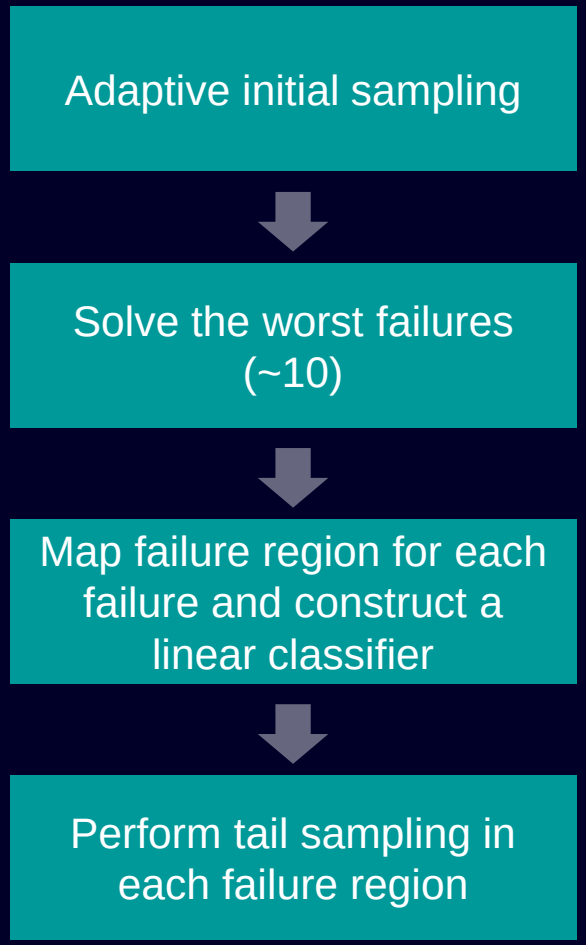
Cloud-optimized for massive scalability with **AWS** and **Azure**

2024: Solido Sim AI Variation Technology

All-new breakthrough 3rd gen AI tech for variation analysis

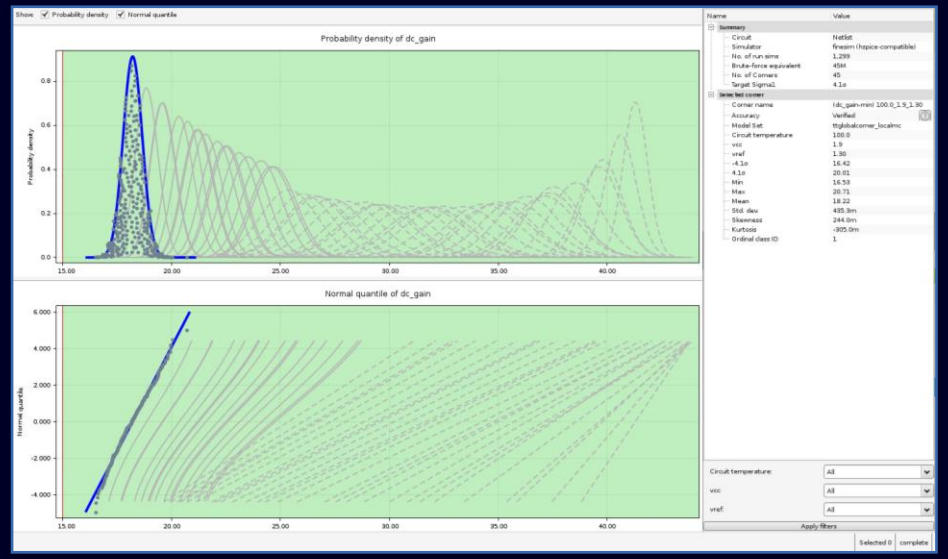
- **High-sigma verification mode**
  - 4x-20x faster runtime than Solido HSV
  - Same accuracy as Solido HSV
- **Corner screening mode**
  - 50% faster than Solido PVTMC
  - More accurate than Solido PVTMC
    - 100% accuracy in large full library benchmarks
- Extremely easy to use
  - > solidosim –solve-yield <options> mynetlist.sp

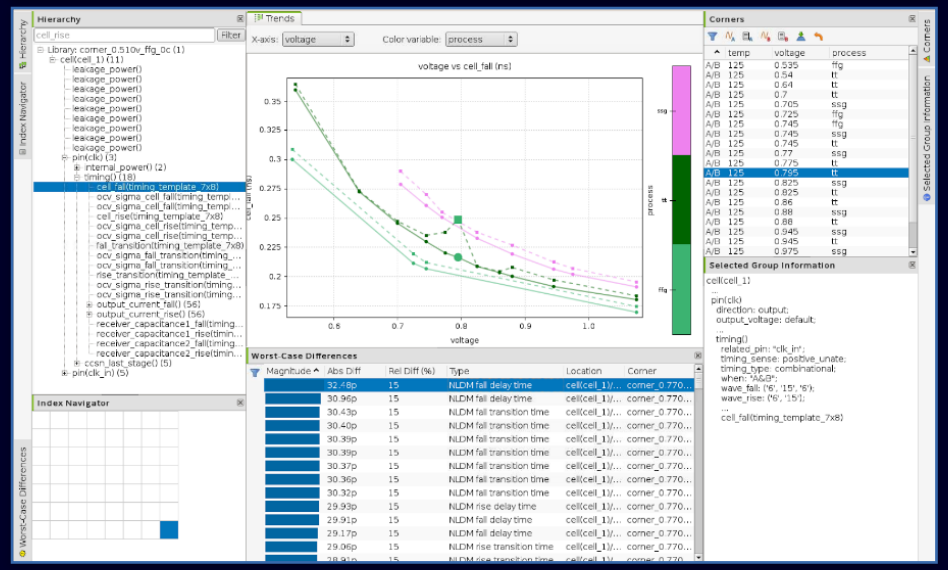
Algorithm Overview



Full Solido Sim AI roadmap for speeding up every part of simulation

Solido AI Driven Custom IC Verification





Solido Design Environment

- 2-50x faster PVT analysis
- 10x-100x faster 3-sigma Monte Carlo
- >1Mx 6-sigma Monte Carlo

Solido Characterization Suite

- 100x-1000x faster Liberty model generation at new PVTs
- >10x faster liberty debugging
- 2x-6x faster characterization

Solido Simulation Suite

- 4x-10x faster SPICE simulation
- 4x-1000x faster FastSPICE simulation
- 2x-8x faster batch simulation

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Solido continues AI technology leadership

AI Innovation

Adaptive AI	Additive AI	Internal AI	Generative AI
10X+ verification and characterization speedup	10X+ speedup by retaining and re-using AI models	10X+ faster runs with in-simulator AI engine	10X+ engineering multiplier with LLM-powered EDA platform
Solido Design Environment Solido Characterization Suite	Solido Design Environment	Solido Sim AI	Siemens EDAi

Standalone external AI layer → **Tightly-embedded internal AI** → **Pervasive AI platform**

Siemens EDA Delivers AI Benefits Across the Full Design Flow

Flow	Function	SEDA Tool	AI Benefit Highlights
System Design	Emulation/Prototyping	**Veloce**	**50% reduction in RTLC compile time and 100% increase in throughput**
IC Functional Design	Digital Verification	**Questa**	**3x reduction in verification coverage closure time and 10x reduction in the verification of design changes**
IC Functional Design	Custom IC Verification	**Solido**	**2-1000x+ faster simulation and analysis**
IC Functional Design	Design for Test	**Tessent**	**10x faster architecture implementation and 5x shorter test time**
IC Physical Design	P&R Floorplanning	**Aprisa**	**Reduced cycle time from ~3 to 4 weeks to 1 day with 17% improvement in wire length and 13% improvement in TNS**
IC Physical Design	Reliability Checking	**Calibre**	**60-400% runtime improvement with ML-optimized resource distribution**
IC Physical Design	Hotspot Detection	**Calibre**	**100x runtime improvement in litho-hotspot detection**
IC Manufacturing	Mask Synthesis	**Calibre**	**2-4x runtime improvement**
IC Manufacturing	Test Failure Diagnosis	**Tessent**	**2.5% yield improvement above entitlement ($M savings)**
System Design	PCB Design Exploration	**HyperLynx**	**100,000x simulation time improvement**
System Design	PDG/PCB Design	**Expedition**	**Real-time ML UI command prediction for user productivity**

Summary

AI is everywhere in Siemens EDA's products, delivering major advantages

Siemens EDA is strategically investing in AI to further accelerate innovation

AI is rapidly changing semiconductor chip design

Better chips

Less time

More efficiently

Thank you