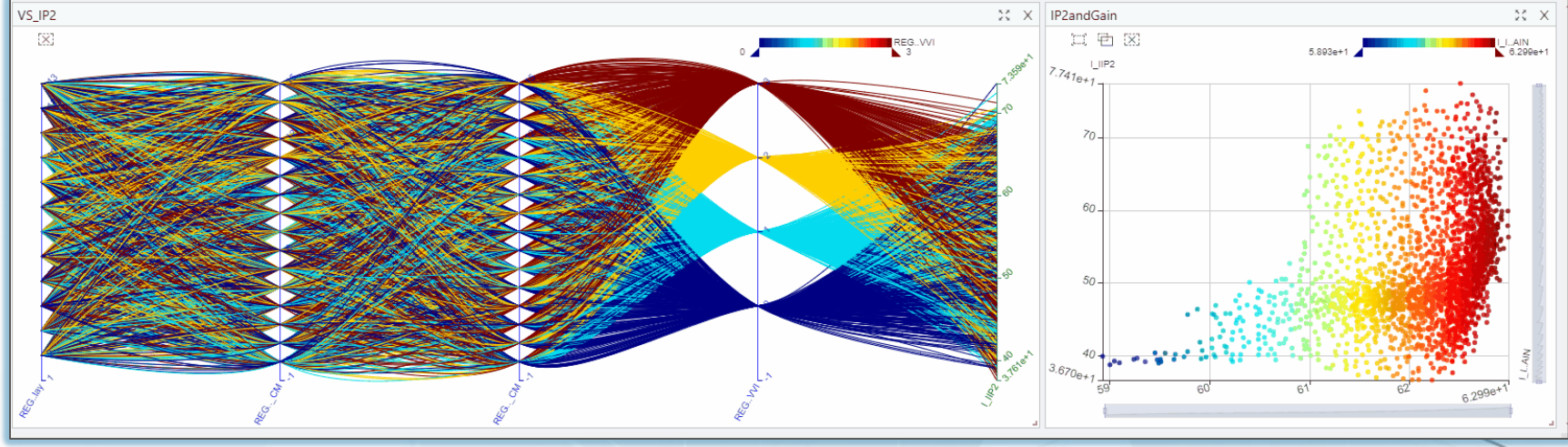

Today’s complexity in validation requires automation by a machine-learning based tool

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Lisa Taubensee

- M.A.Sc. University of Waterloo – Canada (2005)
- Characterization Engineer/AE Gennum Corp. (2001-2006)
- Application Engineer (AE) Texas Instruments (2007-2014)
- Application Engineer (AE) Synopsys (2014-2019)
- Application Engineer (AE) Advantest (2020 – present)

- Currently supporting post silicon validation solutions
- Interested in new validation methodologies
- Interested in the whole validation chain

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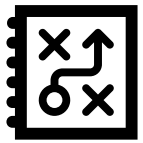
Complexity Demands New Post Silicon Validation Methodology

Complexities: Design performance & modes, process, IP blocks, global teams

PSV must ensure that (physical) chip & FW meet all specifications after tuning under all operating conditions & modes with sufficient yield.

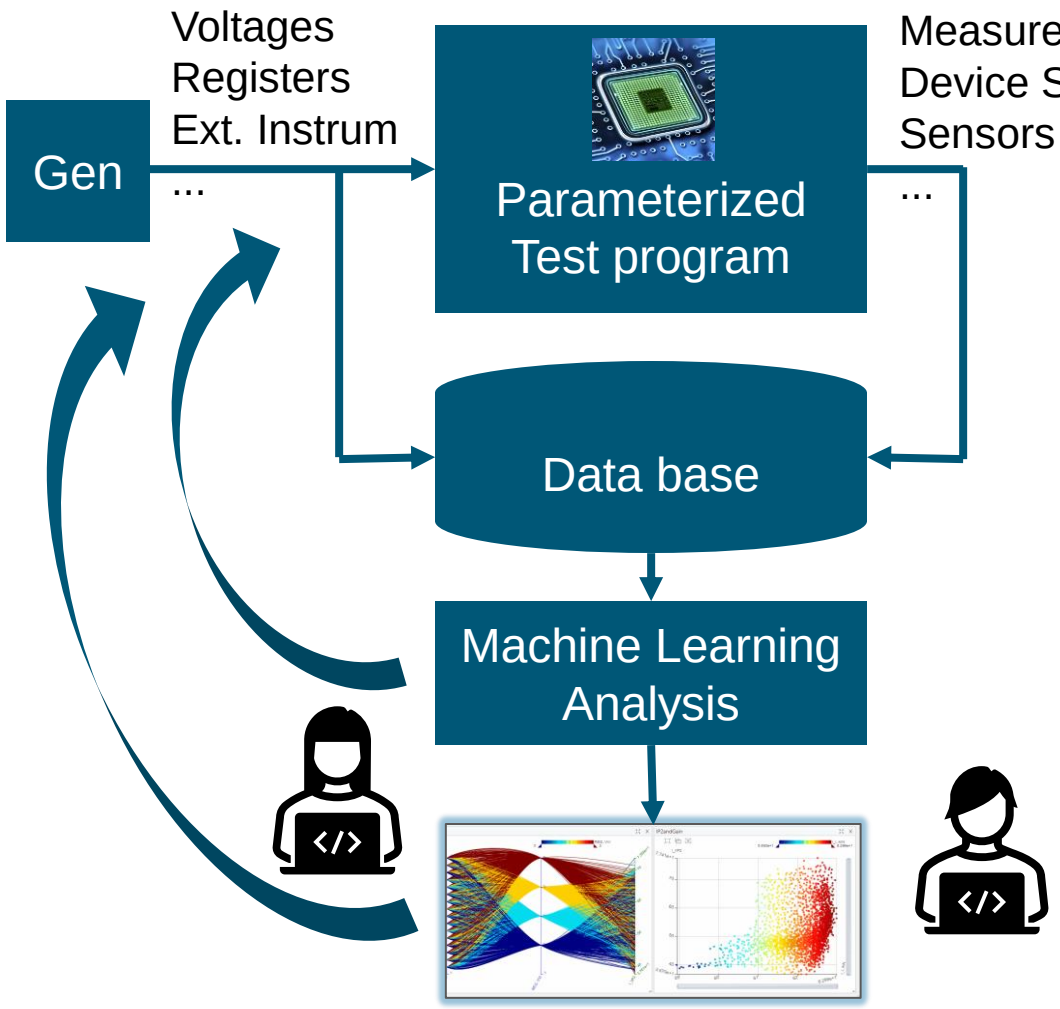
Today's PSV relies on expert knowledge / assumptions. Shmoos scan expected dependencies.



Challenges

- Process variations, design complexity and black-box IP blocks lead to unexpected, hard to debug problems under peculiar conditions
- Schedule pressure
- Increasing quality expectations
- Complex collaboration between global teams
- Tuning becomes too complex
- Few experts

New PSV Methodology



Parameterized test program
- Vary everything, measure everything
- Validates chip + FW + test program

Quality through black-box coverage
- No assumptions → Constrained random tests
- Coverage metrics

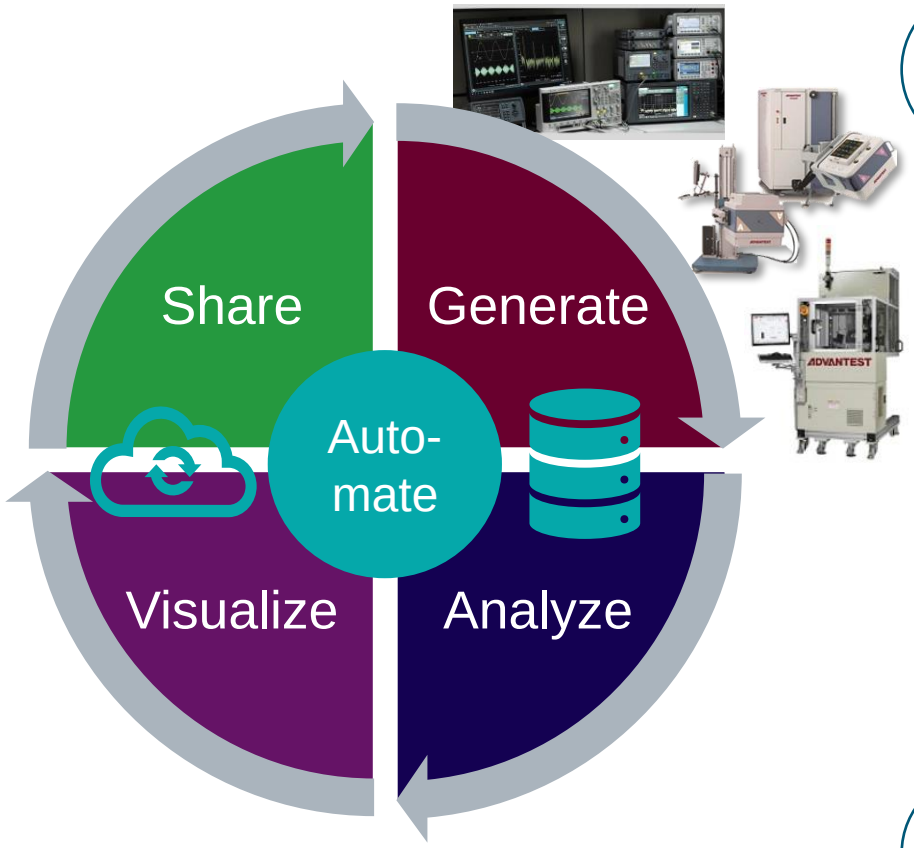
Self-learning device exploration loop

Relate inputs to outputs
- Create model
- Identify important influences
- Debugging & tuning tools

Interactive post-processing analysis
- Based on comprehensive data
- Generate more data from within plots

Generate

Parameterize and execute test cases automatically for comprehensive coverage



- Highly parameterized test program – no assumptions
- High quantifiable coverage through automatic generation of constrained random tests
- Automate connection to test equipment
- Self-Exploration collects relevant data faster
- Linked inputs and output enable modeling of behavior

Random Coverage is Much Higher Than Shmoo Coverage

Scenario: 25 inputs, want to cover all 10% value intervals, 10k test cases.

There are 300 pairs of 25 variables, and 2300 triples.

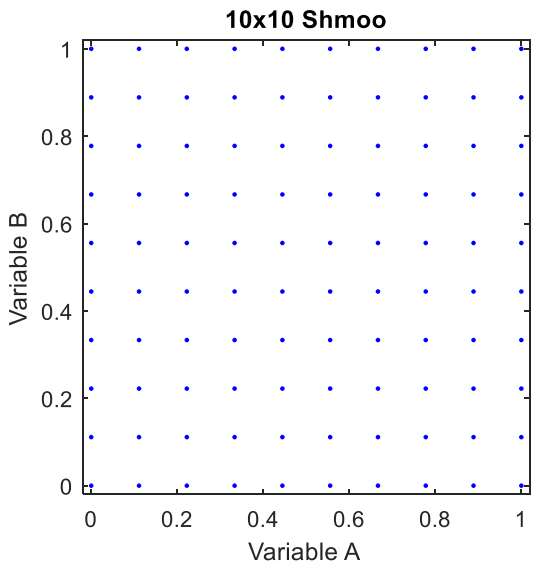
Shmoo: Select 100 suspected most relevant input pairs, run 10x10 Shmoo for each pair.

Pair Coverage: 33 %
(100 % for 100 pairs, 0 % for 200 pairs)

Triple Coverage: 0 %, only pairs were covered.

Shmoos show 100 slices of reality.

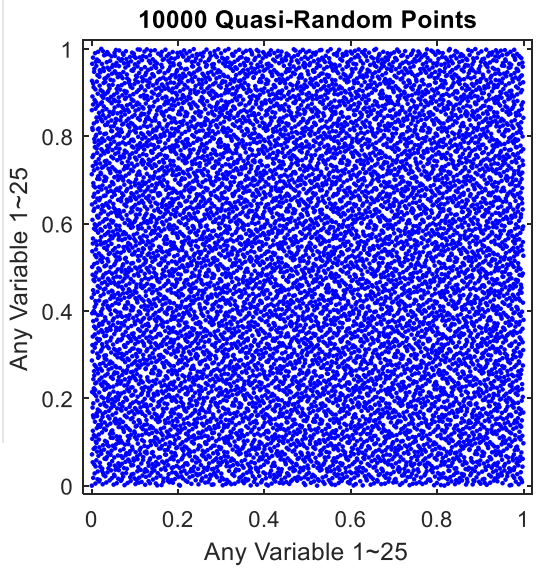
Shmoo tests can find only expected problems.



Random Test: Randomize all input variables simultaneously. Make no assumption!

Pair Coverage: 100 % across all 300 pairs
- Still 100 % with 1k test cases

Triple Coverage: 100 % across all 2300 triples
99.5 % with 3k test cases

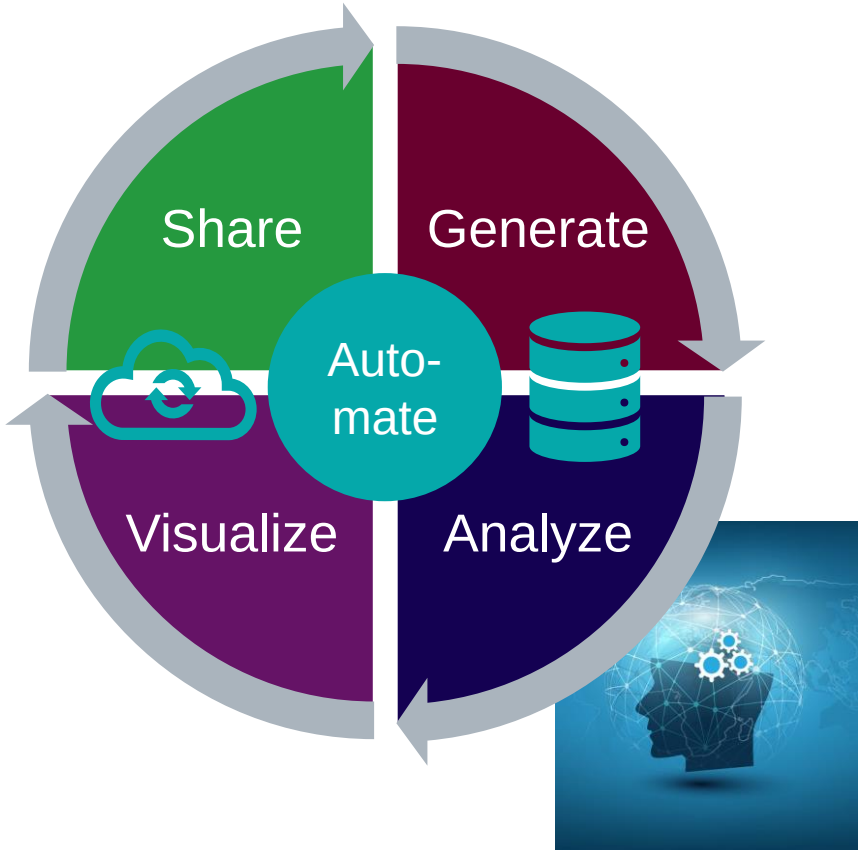


Random tests reveal the whole truth.

Random tests find also unexpected problems.

Analyze

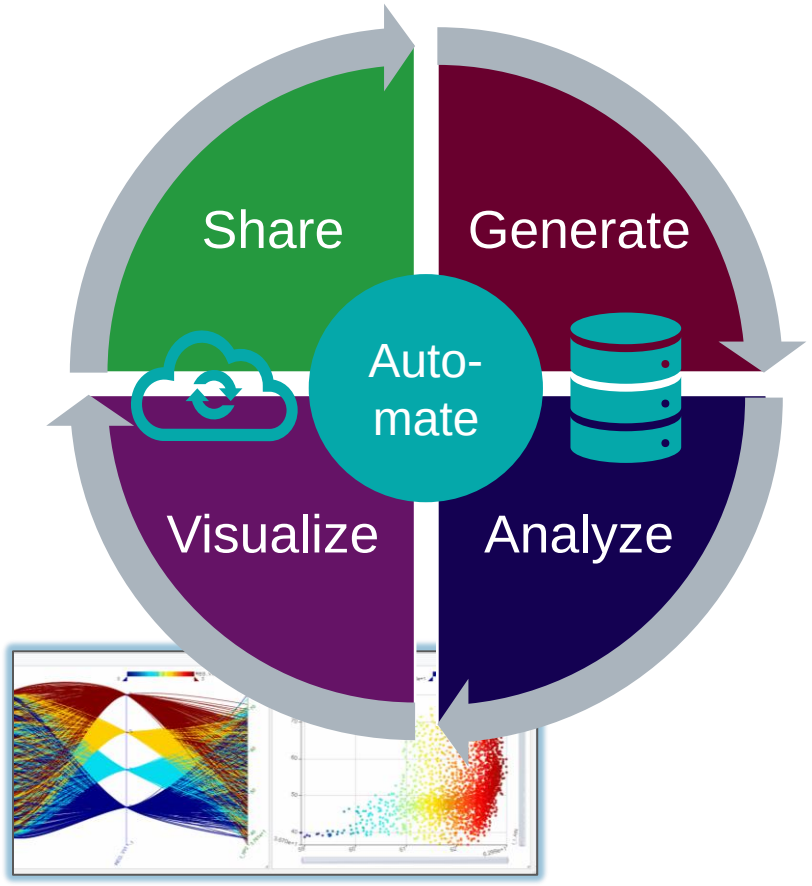
Analyze data immediately as off-line experiments, powered by PSV-specific AI



- Immediate off-line analyses of all gathered data
- Variable selection finds most important dependencies
- Peel-the-onion tool reveals subtle effects
- Split multiple problems for easier debugging
- Model-based what-if analysis
- Automatic AI-based tuning

Visualize

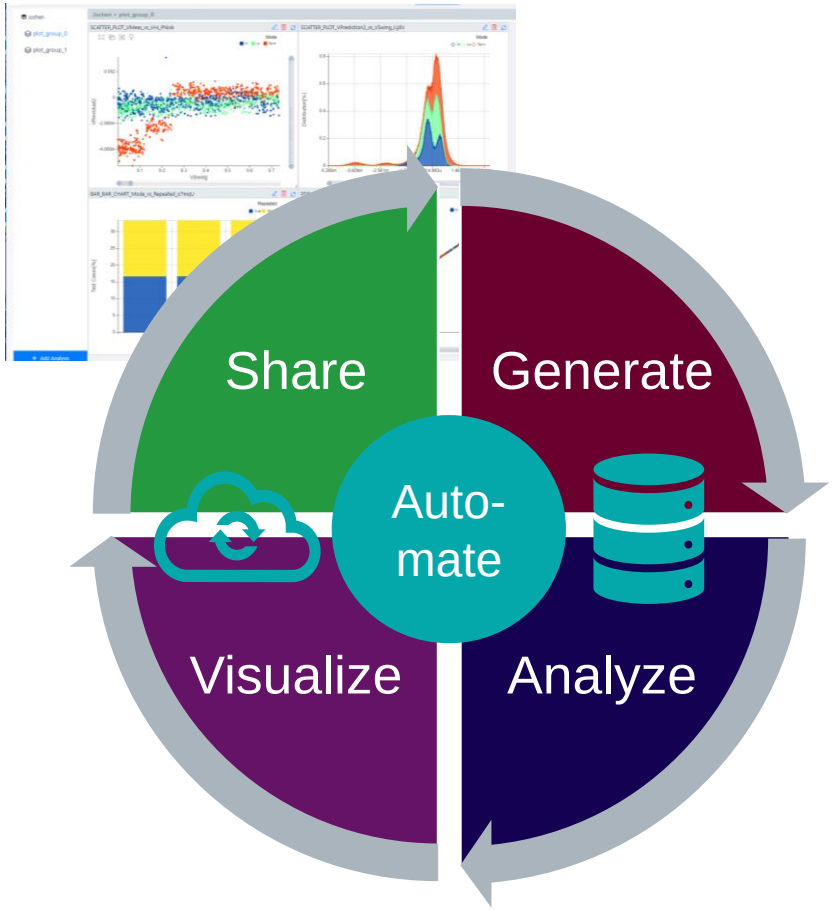
PSV-specific visual analytics for fast insight



- Interactive, linked plots highlight selected data in all plots
- Variable selection picks most informative plots
- Automatic plot type selection
- Highlight statistically significant (small) deviations
- Linked plots of spectra & waveforms
- Interactively run tests from within plots

Share

More efficient, unambiguous communication across the globe, 24/7



- Shared access to data and visualizations
- Unambiguous data-driven communication
- Dashboards to monitor PSV progress
- Reports for external partners and archive

Conclusion

The current PSV methodology does not hold for modern complex designs

Traditional methods do not find unexpected problems and are shown to be inefficient

We have come up with a new methodology and tools which deal with these challenges