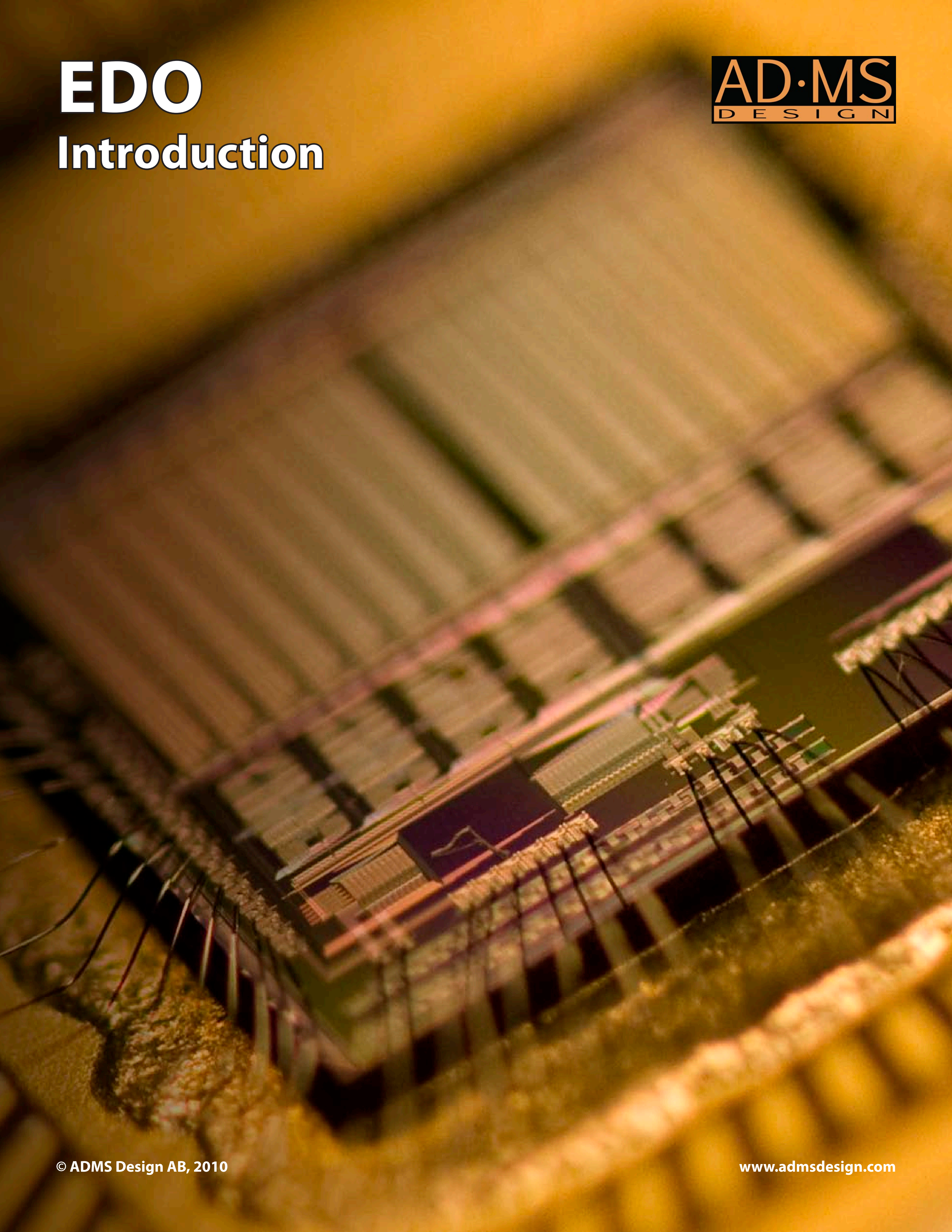
EDO

Introduction



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Experience-based Design Optimization

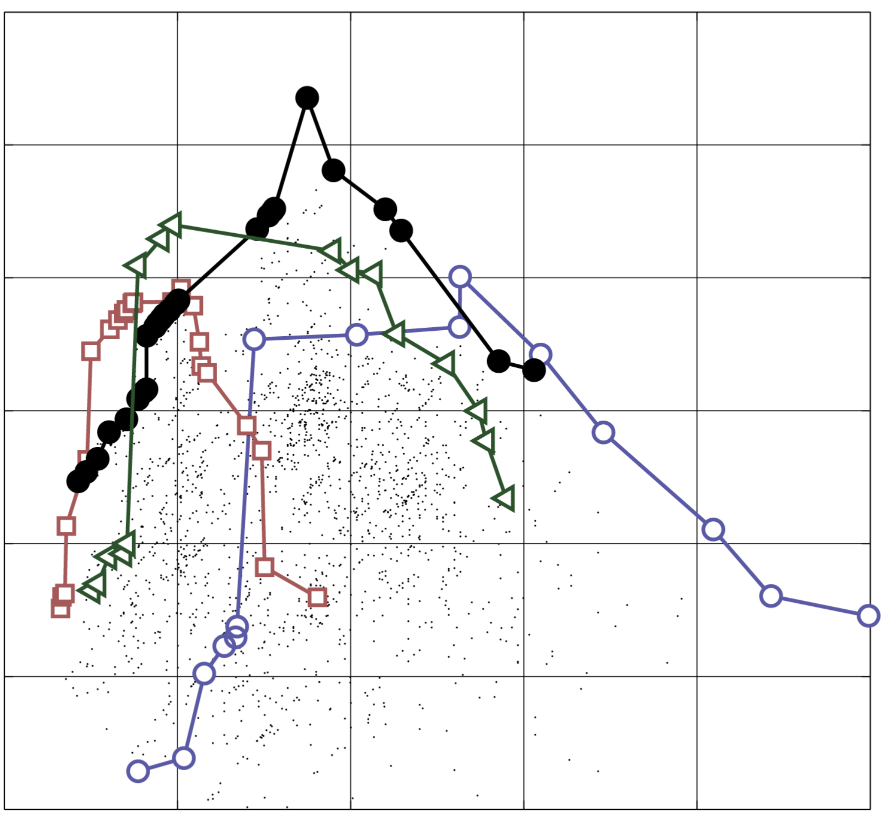
Benefit from work already done by others

Facing a new design specification, there is nothing that can replace the first-hand experience of your design team. If the next project requires only minor tweaks of a previous design, that's great. Probably no reason then to "go the extra mile" looking for design options. But when taking a larger step towards higher performance, lower power, or even drafting a new product family, you want to make sure that decisions are based on the best available information. ***Experience-based Design Optimization*** (EDO) supports you in that.

EDO is based on the collective experience of the field as represented by design and performance data reported for thousands of commercial and experimental IC designs in data-sheets and scientific publications over the years. Through systematic analysis of this data it is possible to extract how performance correlate with design parameters, power dissipation, architecture, and other distinctive features of the implementation.

On a first level, a new design spec can be placed in the context of all previous attempts in order to assess its level of difficulty. Going further EDO enables the search for an optimal architecture, process or power supply – to the degree that such parameters can be freely chosen. Other aspects that are important in early decision making are chip area and power dissipation. EDO allows you to make educated estimations of these parameters and also to identify alternative design options that can further improve your design.

By using EDO, you are systematically leveraging knowledge derived from other designers attempts, without the lead time and cost of making your own circuit prototype.



EDO example: State-of-the-art limits for one performance parameter vs. another performance parameter of interest plotted for four different ADC architectures.

Experience takes time

Having assembled a skilled and motivated design team, the only real limit to building first-hand experience internally is the time it actually takes to design, tape-out and evaluate a circuit. Most IC designers are unlikely to design and evaluate more than 1-3 new designs per year. Over a ten-year period, perhaps 15–30 designs, and a significant part will be variations within the same product line.

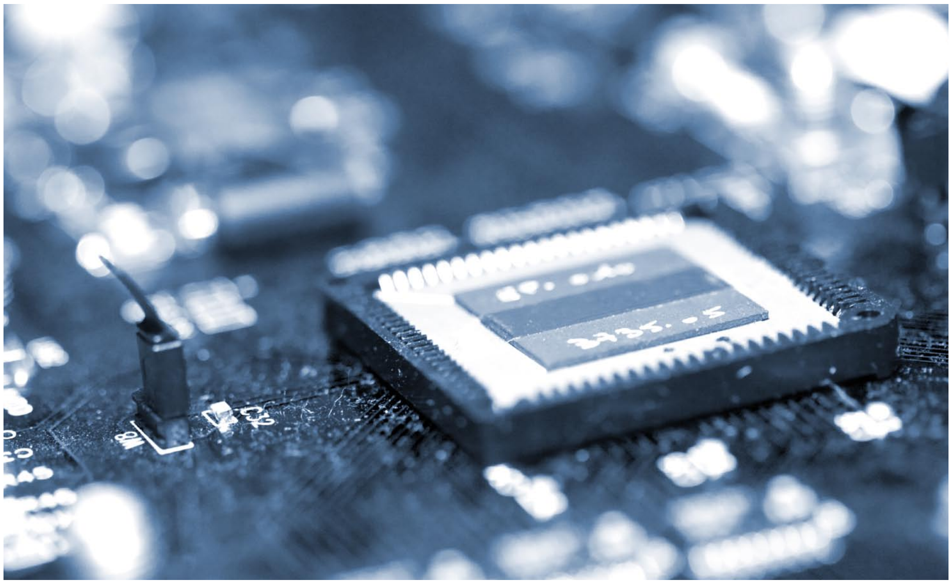
This is where the experience of others becomes an important extension of, and a complement to first-hand experience. Motivated designers therefore stay updated by going to conferences, reading data sheets, industry news, and scientific publications to the extent that their workload allows them. Combining such information with personal experience enables a designer to make more educated decisions on new designs, and this is a natural part of most R&D work.

Experience-based Design Optimization takes that approach to the next level as it ***augments*** the ability to factor in the experience gathered by others by systematically considering all available information relevant to the project at hand. Using custom-designed analysis software and a pre-compiled database with near-exhaustive coverage of all publicly reported scientific and commercial implementations, EDO provides a summary of relevant information that simply cannot be matched by ad hoc methods.

In the early stages of a design project – such as the pre-study or feasibility study, such information is precious. Advantages include the possibility to quickly reject unfeasible design targets, avoiding resource allocation to projects that are likely to fail, proving that current design choices are in fact optimal, or alternatively identifying new and better design options.

Virtual Prototypes

Cost-effective "design reuse"



Instead of making several prototypes to evaluate alternate architectures or design ideas, why not first use the circuits already developed by others to test your ideas. Use them as "virtual prototypes", at a fraction of the cost to make your own – and with *zero lead time*.

Eventually, there is no escaping your first silicon. But these designs have already been manufactured, measured, documented ***and paid for*** - by others! Once your design concept has been confirmed or refined using EDO, resources can be allocated to designs that will actually hit the mark.

It should be understood that EDO is not primarily about finding a few publications or data-sheets that prove feasibility based on the fact that the design targets at hand have already been met by prior-art. EDO goes far beyond that.

Rather than simply matching a design spec with prior art, EDO looks at all the relevant data in order to determine how various performance metrics correlate with design switches and design parameters relevant to your project. Feasibility and the level of difficulty can then be determined also when there is no exact match in prior-art, and even if the design target is beyond the current state-of-the-art. The same goes for predicting performance and optimizing the design. The only requirement is that there is a sufficient amount of data to accurately estimate the correlations between the design parameters of interest and performance – including the extrapolation or interpolation necessary to cover the specification range of the design at hand.

(*See also "How useful is an old scientific publication anyway?"*)

How useful is an old scientific publication anyway?

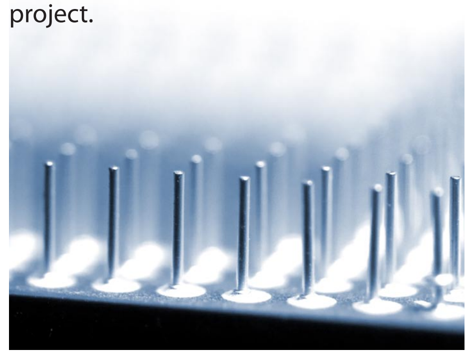
Why consider data from a 10-year old circuit when designing in the latest CMOS technology and towards performance targets only dreamt of ten years ago?

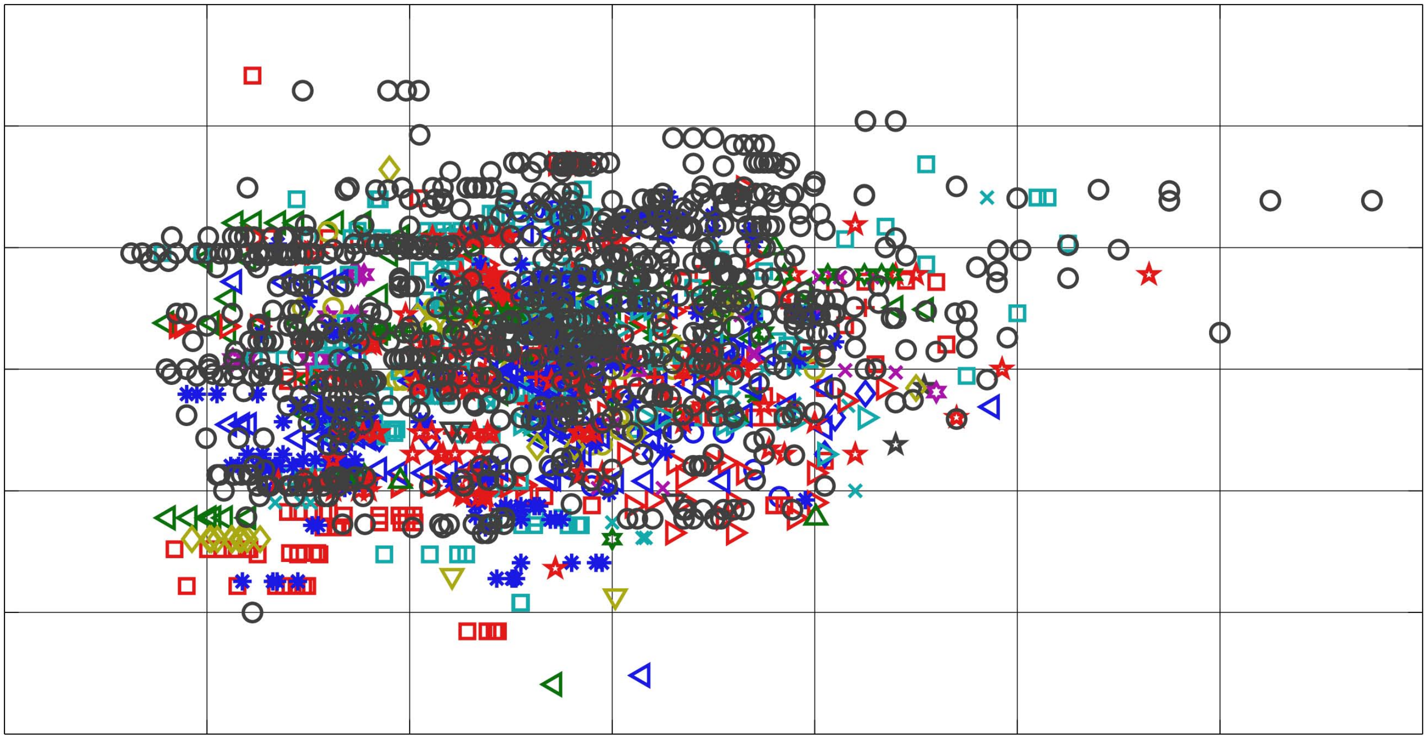
The main reason to look at *all* data is to make better interpretations and estimations of correlations and trends. Just as it is impossible to define a direction from a single point, the correlation between performance limits and design parameters is better understood by looking at a broader range of the design parameter than by only zooming in to a narrow range of interest. As an example, the current rate of performance evolution is more accurately understood by looking at all data and not just data from the last 2–5 years.

As another example, the performance limit at 0.9V supply is more accurately predicted by also including 3.3 and even 5V data than by only including 0.6–1.2V designs because the performance vs. supply voltage curve is likely to be a continuous function of some kind. Considering all data then allows to more accurately define the shape of the function, and to some degree compensate for the lack of data at ultra-low supply voltages. As an early adopter, designing in the most recent CMOS nodes, old and seemingly "irrelevant" data may be all you've got to get direction from. But again, with a good method and under the assumption of continuous functions, this data may serve you very well.

CHALLENGE OLD "TRUTHS"

EDO allows you to challenge old "truths" and traditions – or to validate them. The goal is not to overthrow proven design practices and hard-earned experience. EDO may just as well confirm and support the current direction. The key point is to liberate design projects from what may be nothing more than opinions or misunderstandings. As an example, scientific papers or commercial promotion sometimes makes claims like "*architecture A is more power efficient than architecture B*". With EDO it is easy to verify how well such a statement aligns to all known attempts in the field, and to what degree it is relevant in the context of a particular project.





Take the guesswork out of your design by systemically reusing the results of others. The scatter plot example above shows how a certain performance parameter correlate with a particular design parameter in different subsets of the database.

Under the hood

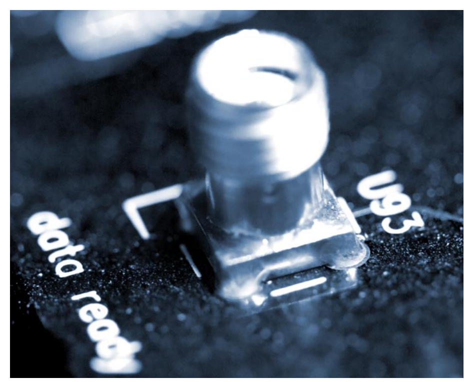
Data, data, and more data

Experience-based Design Optimization is based on massive amounts of carefully collected data, custom analysis tools, and a solid first-hand understanding of circuit design.

A first pillar of Experience-based Design Optimization is the access to *large amounts of experimental data*. ADMS Design AB has collected design and performance data from thousands of scientific or commercial A/D-converter implementations. Over 1500 scientific papers – close to the entire body of ADC research ever reported – have been carefully read, interpreted and scanned for measured performance data. In order to ensure the best possible interpretation of reported data, every single paper was reviewed by a senior data-converter IC designer with well over 15 years first-hand experience of ADC design and implementation and a Ph.D. degree in the field. Design choices such as ADC architecture, calibration mode, device type, process technology, supply voltage, and many more were recorded together with static and dynamic performance data, power dissipation, etc.

Using the second pillar of EDO – *custom data analysis software* – the collected data is systematically analyzed. By observing how performance correlates with different design choices, highly educated and empirically well-founded design decisions can be made early in a project.

The third pillar of EDO is *a thorough insight and understanding* of data converter design. EDO does not replace thinking designers and architects – it just provides a larger and more unbiased view of the available options and their consequences. Combining the insight contributed by ADMS Design AB with the experience and preferences of the client allows the design choices to be optimized for each unique client project.



CONTACT AND FURTHER INFORMATION

Contact ADMS Design AB for more information and to discuss how to best use EDO in your design projects:

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