RUB

RUHR-UNIVERSITÄT BOCHUM
Horst Görtz Institute for IT-Security

Assessment of Hiding the Higher-Order

--what are the achievements versus overheads?--

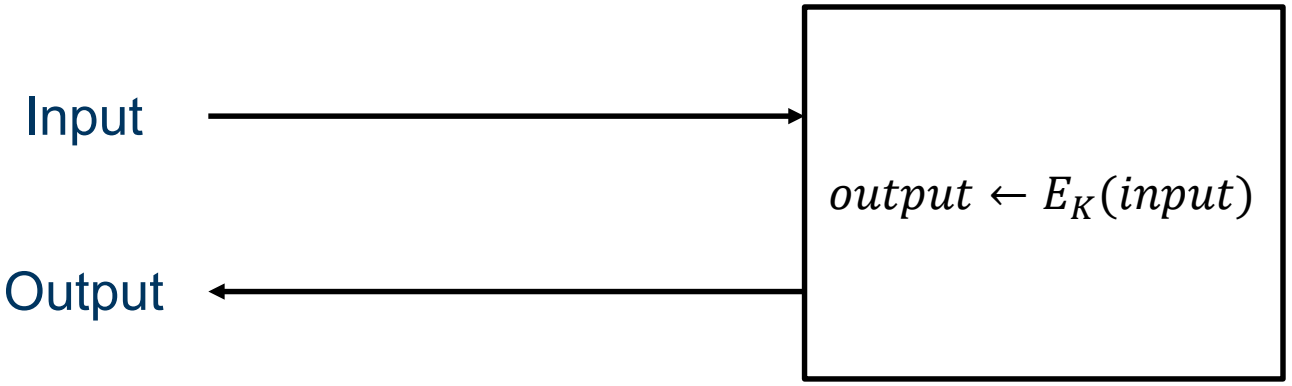
Amir Moradi, Alexander Wild

hgi
Horst Görtz Institute
for IT-Security

September 16, 2015

Intro to SCA

Attack Model



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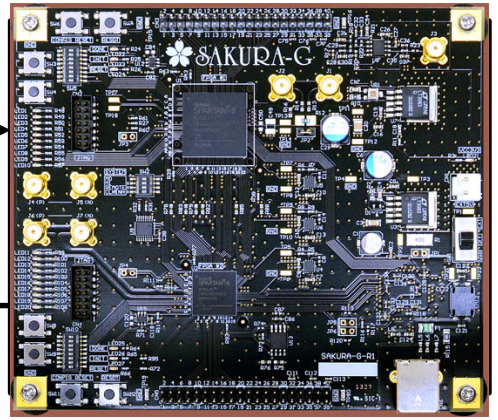

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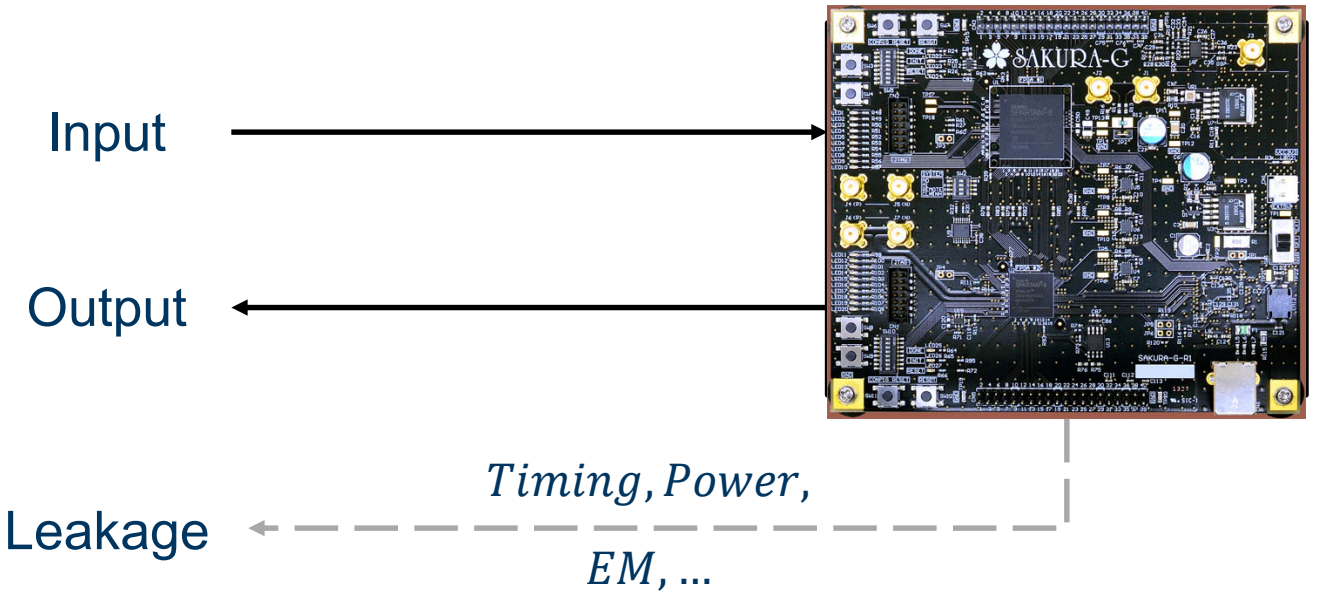

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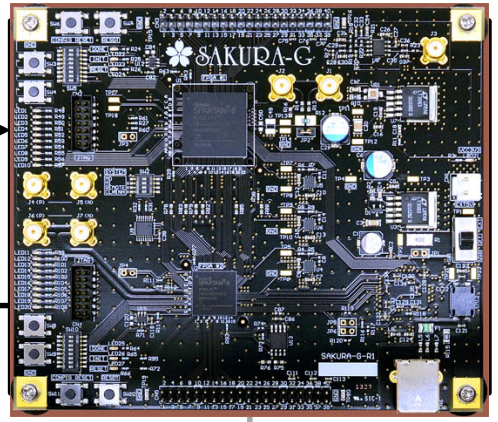

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Leakage

$Timing, Power, EM, \ldots$

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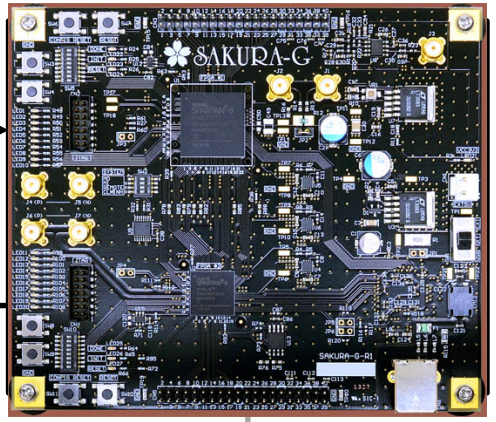

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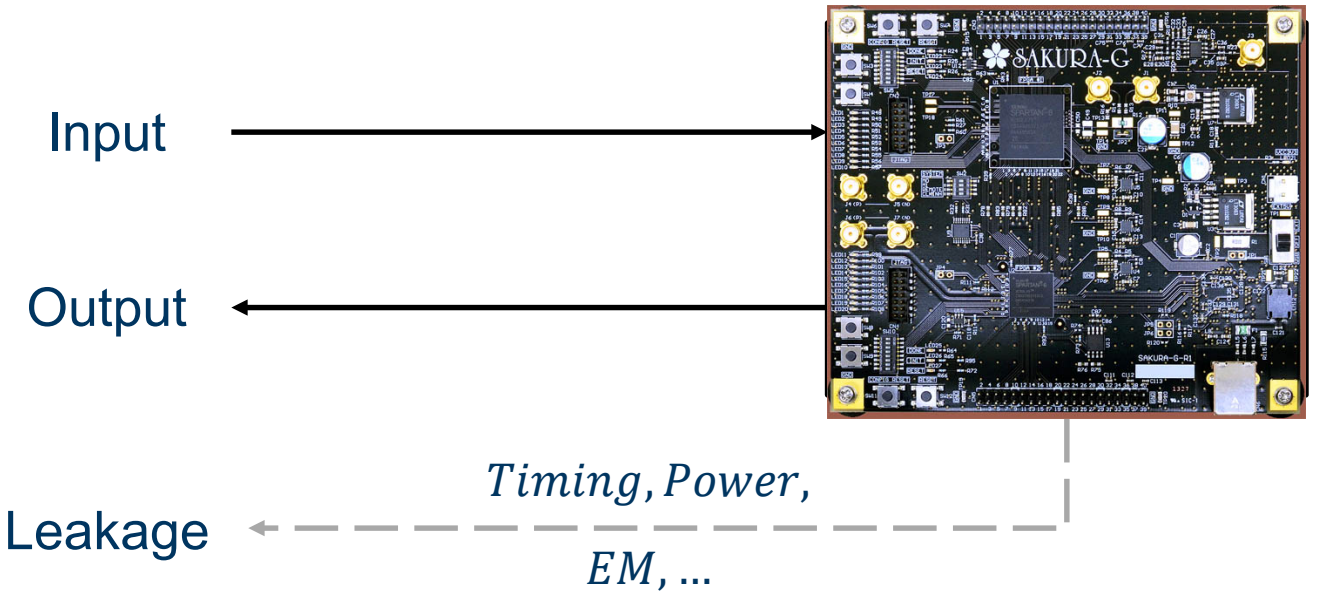

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- Combine hiding with TI
  - Often suggested but "never" examined.

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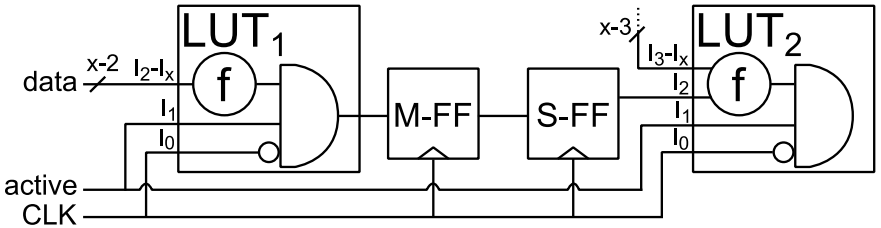

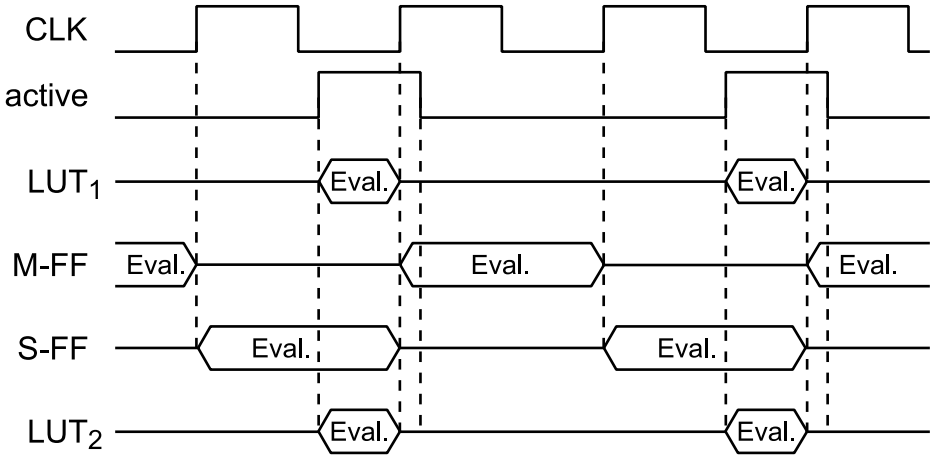

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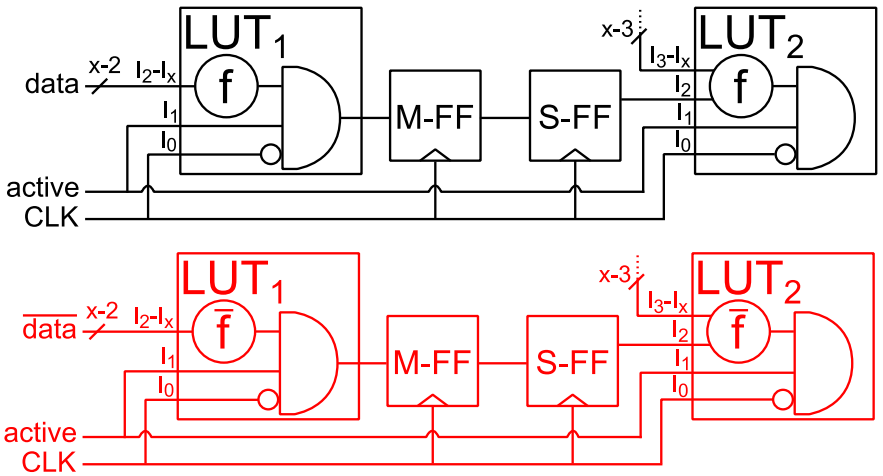

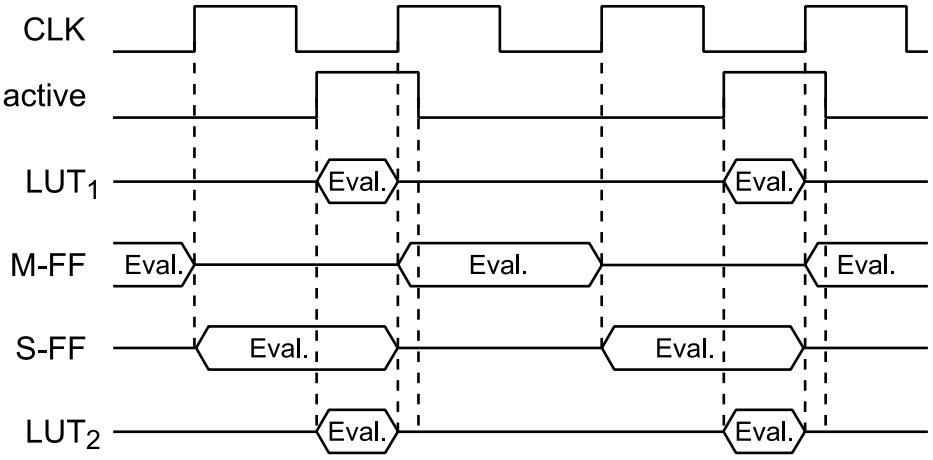

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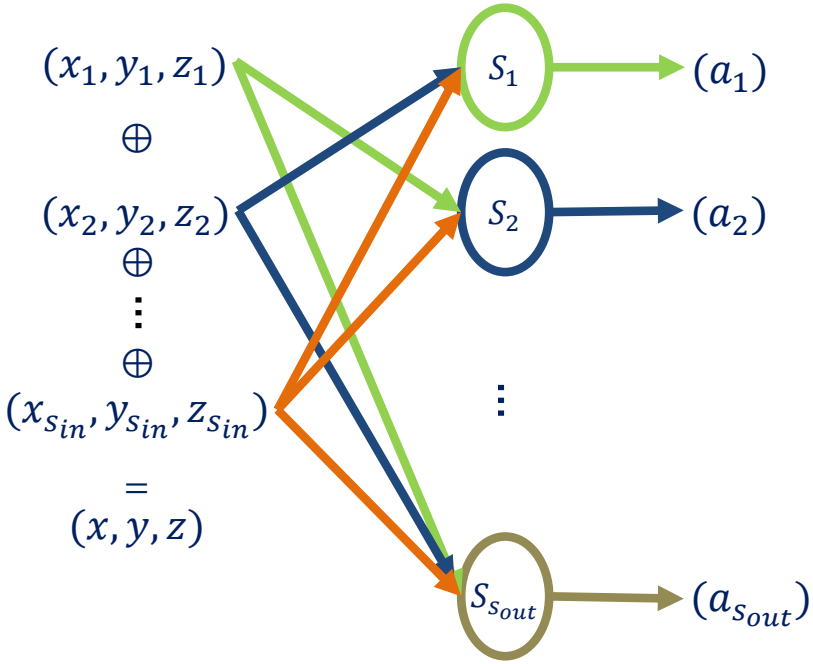

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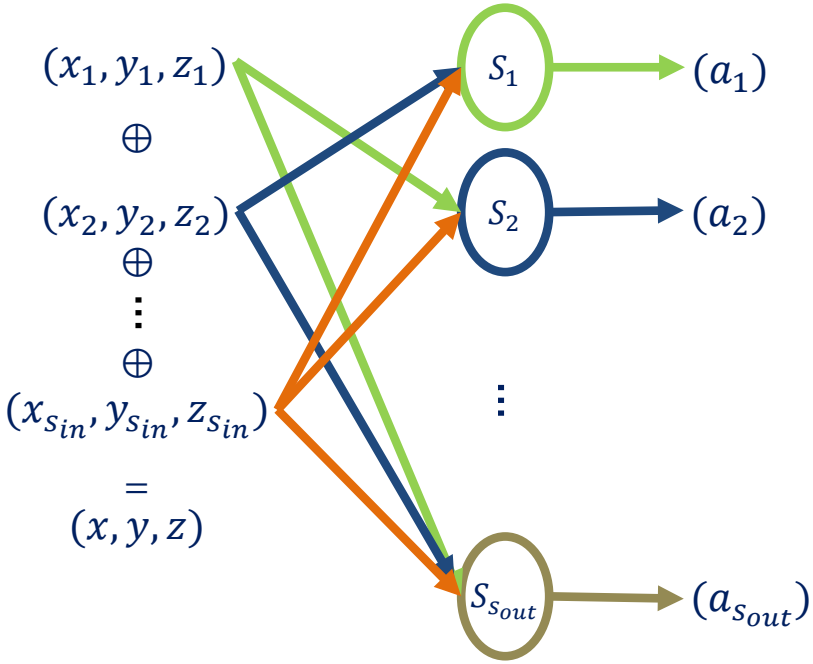

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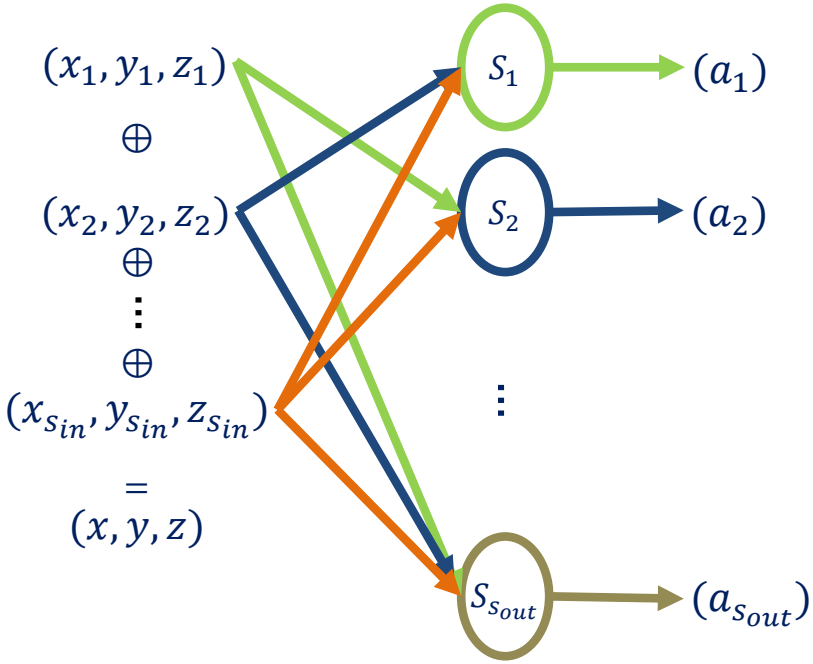

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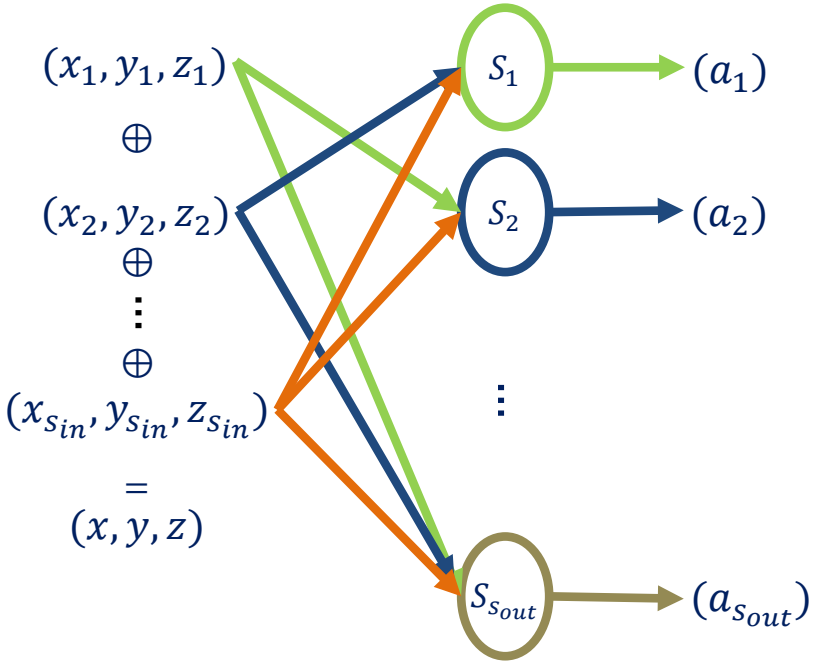

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    - $1^{st}: s_{in} \geq 3, s_{out} \geq 3$
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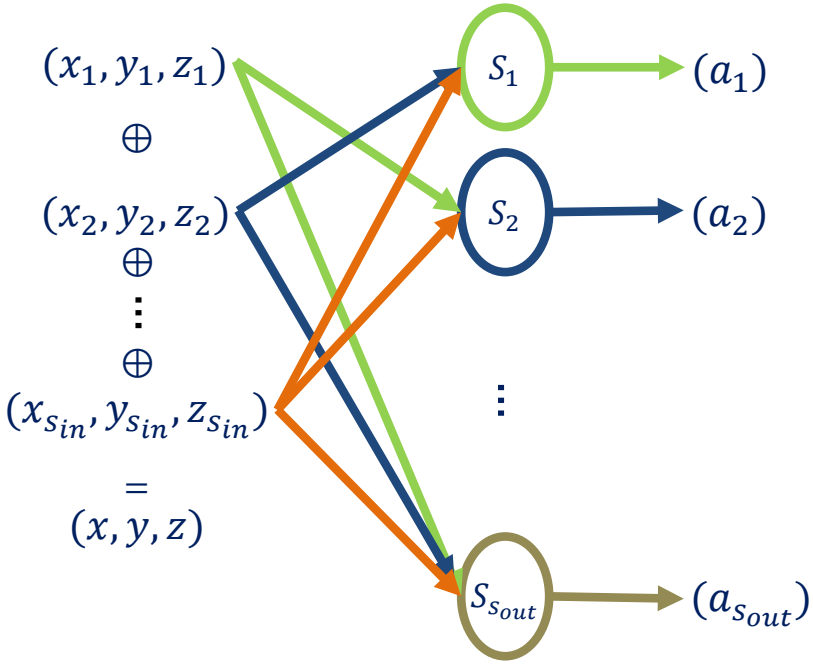

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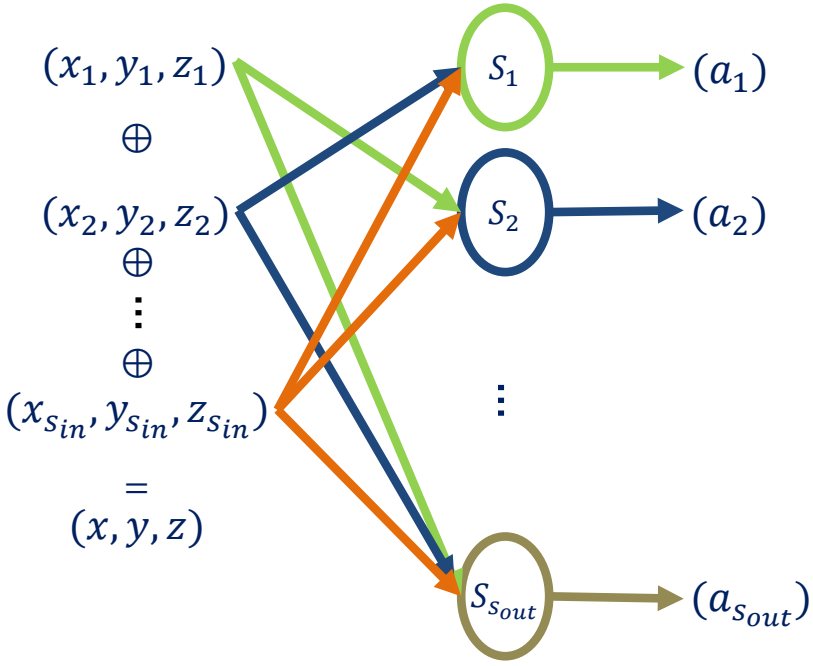

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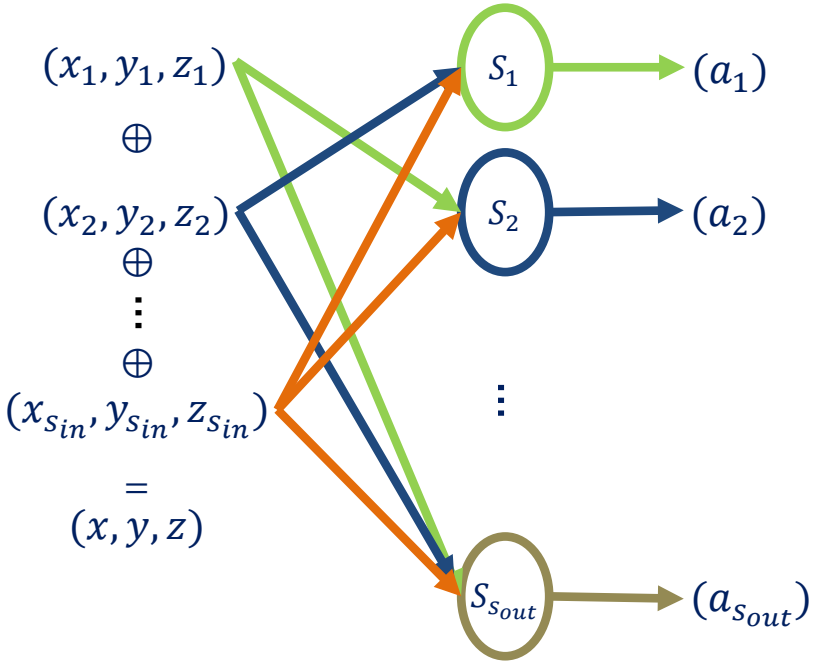
- Registers after nonlinear functions



Case Studies

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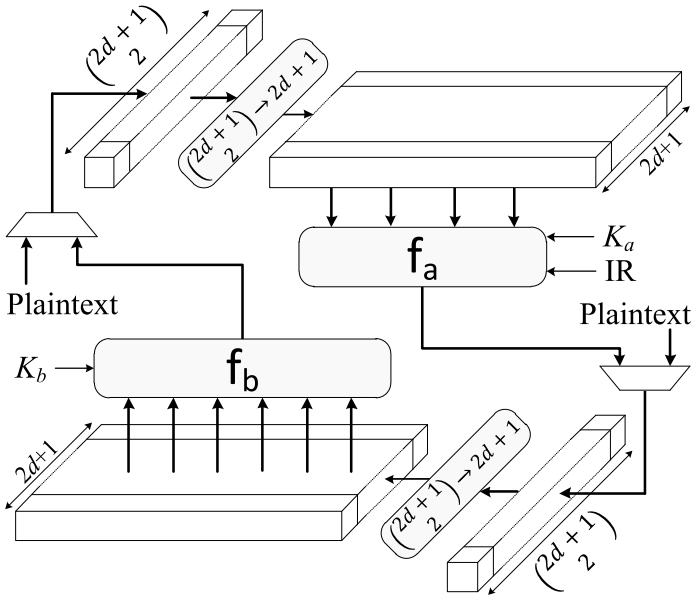
- KATAN-32
  - 1st-order TI
  - 2nd-order TI
  - 1st-order TI by GliFreD



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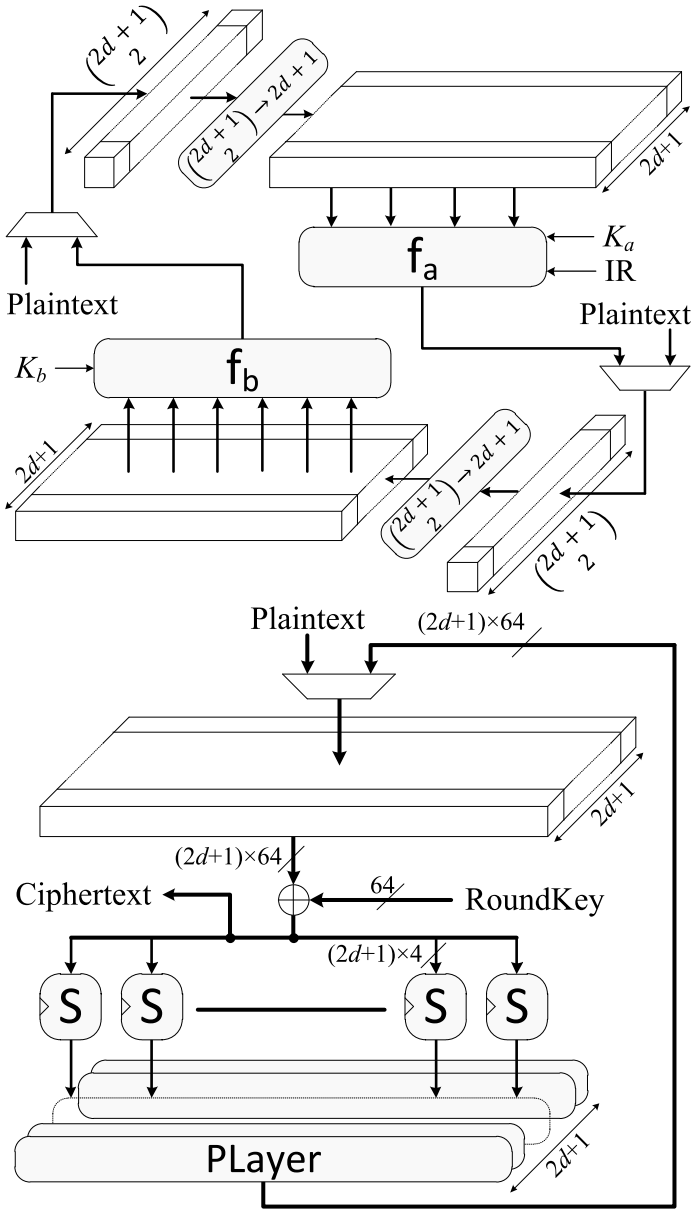

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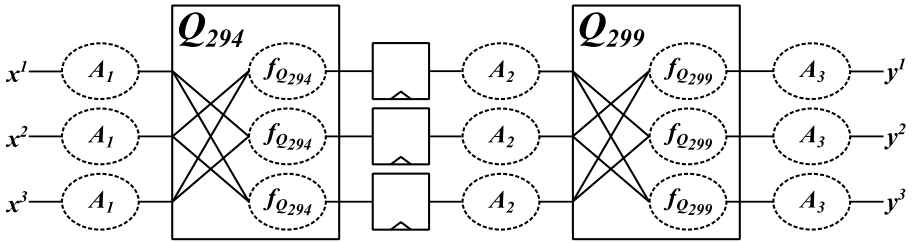

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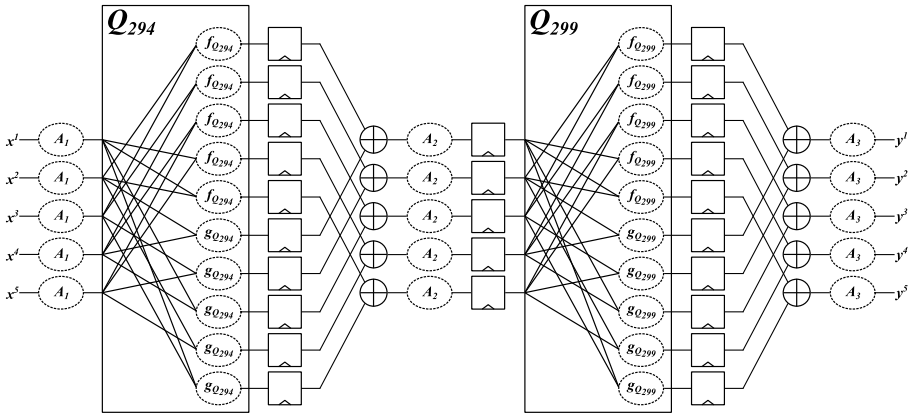

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KATAN-2nd	65	180	321.54	273	1	37.69
KATAN-1st-G	114	548	438.21	546	1	25.68
PRESENT-1st	808	384	206.61	64	2	413.22
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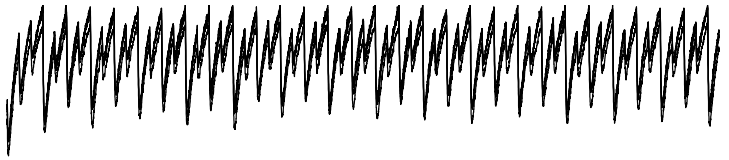

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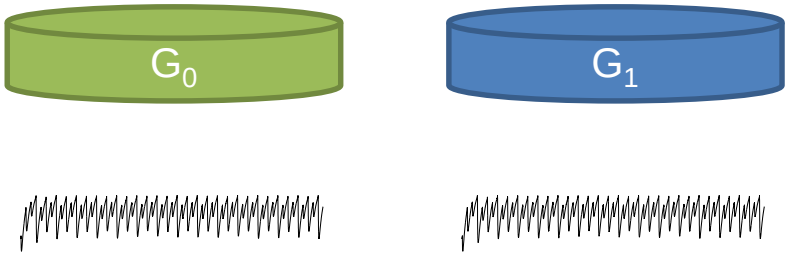

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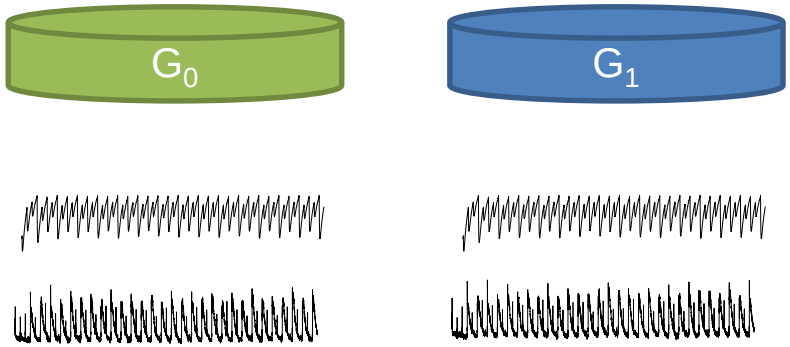

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Where μ denotes the *sample mean* and δ denotes the *sample variance*.

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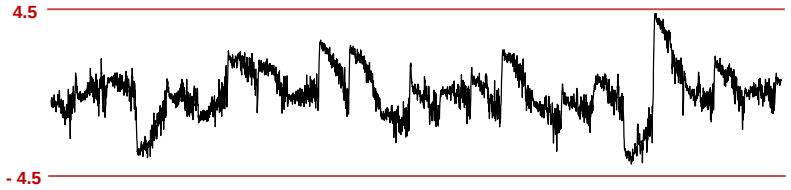

Fail/Pass Criteria: If there is any point in time for which the t-statistic exceeds a threshold of $\pm$ 4.5 the device under test fails.

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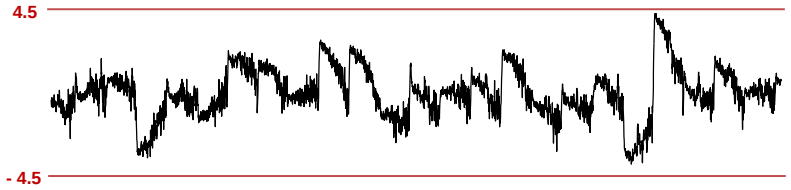
$$t = \frac{\mu(T \in G_1) - \mu(T \in G_0)}{\sqrt{\frac{\delta^2(T \in G_1)}{|G_1|} + \frac{\delta^2(T \in G_0)}{|G_0|}}}$$

Where μ denotes the *sample mean* and δ denotes the *sample variance*.



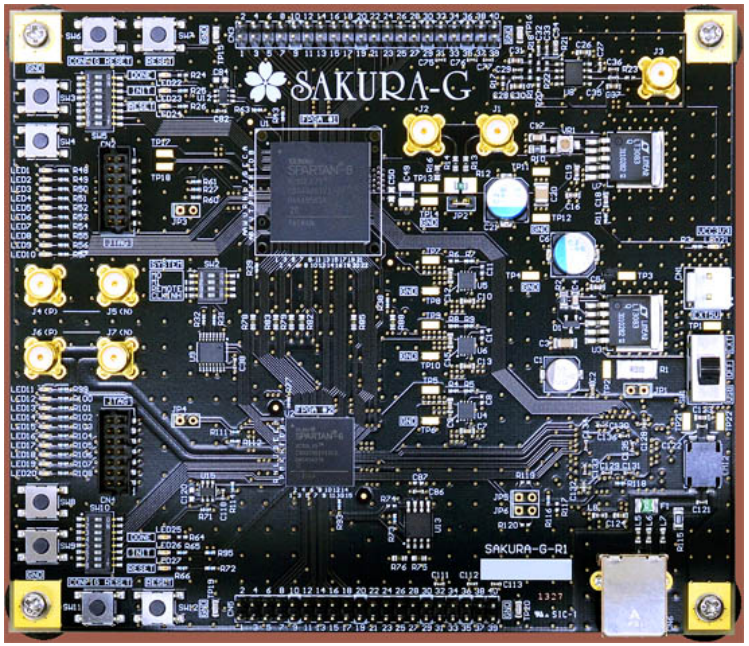
Fail/Pass Criteria: If there is any point in time for which the t-statistic exceeds a threshold of $\pm$ 4.5 the device under test fails.

T. Schneider, A. Moradi. Leakage Assessment Methodology - a clear roadmap for side-channel evaluations. CHES 2015

Evaluation

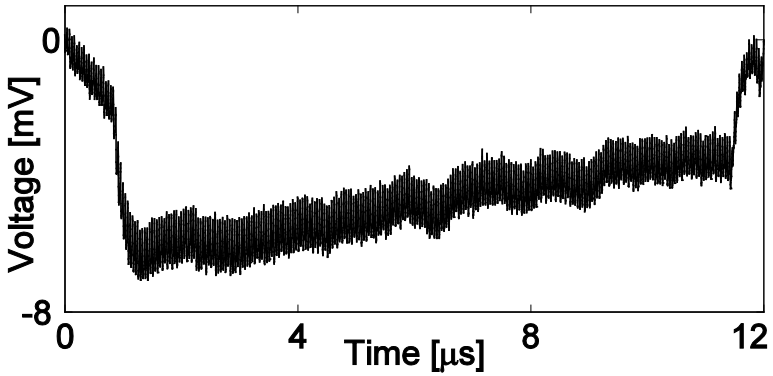
Setup

- SAKURA-G
- Running the designs @ 24MHz
- Measurements with 500MS/s
- Several million traces
- Non-specific *t*-test
  - 1st- to 5th-order
  - Depends on used shares

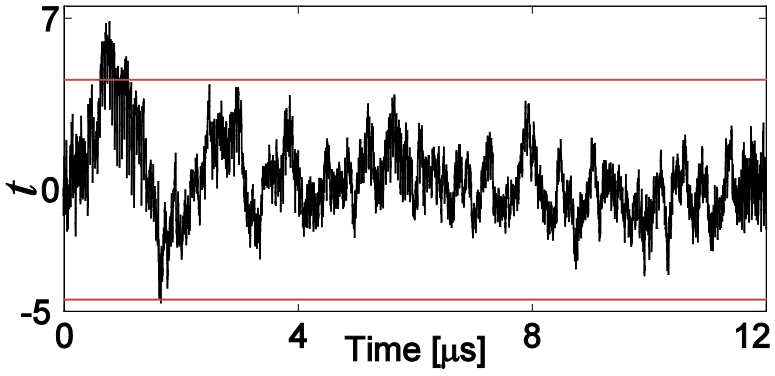


Evaluation

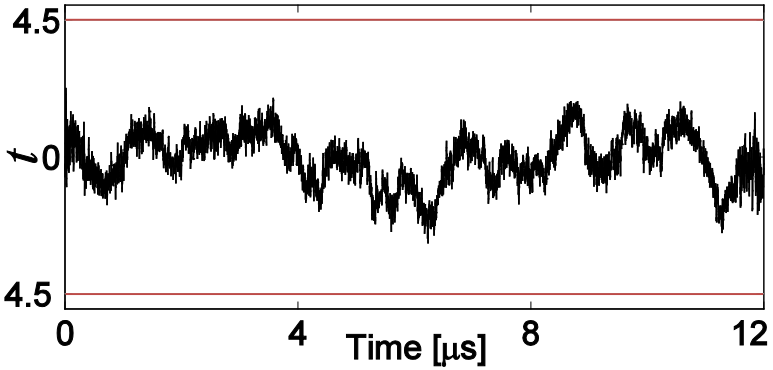
KATAN-1 ST (1 Million Traces)



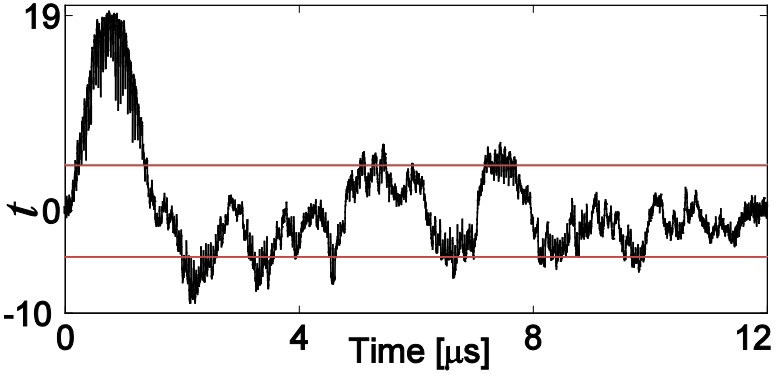
Sample Trace



Second-Order



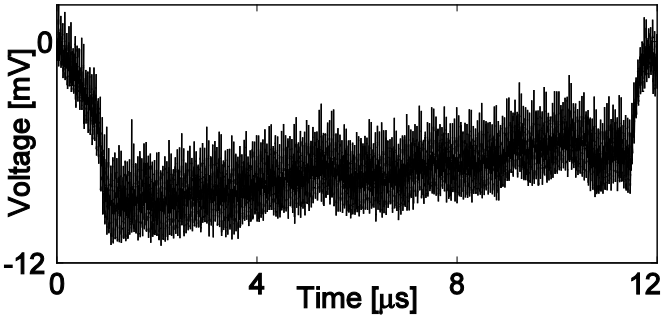
First-Order



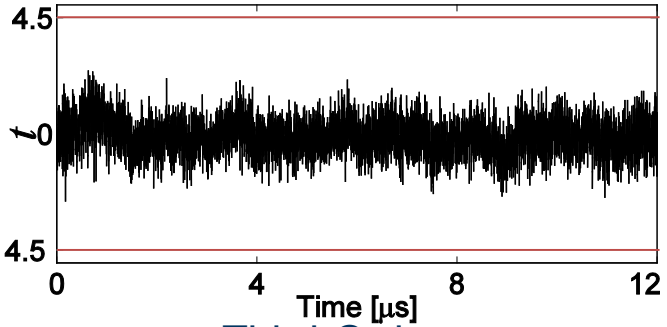
Third-Order

Evaluation

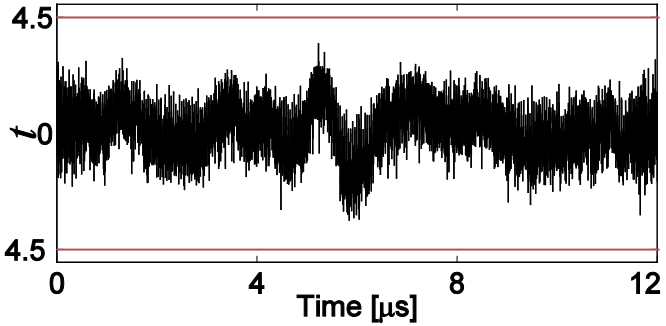
KATAN-2ND (100 Million Traces)



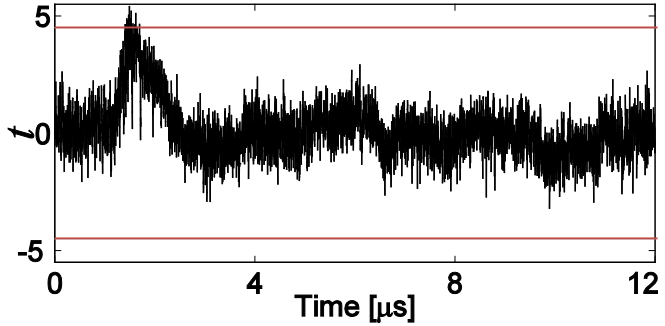
Sample Trace



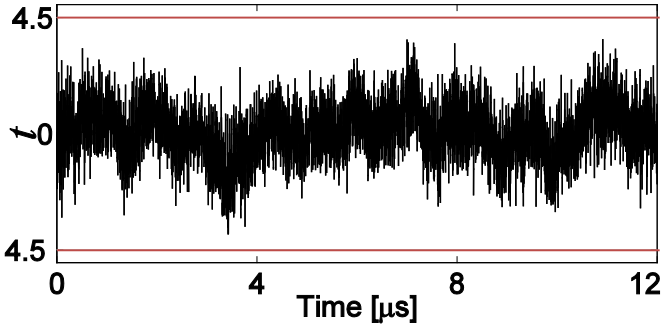
Third-Order



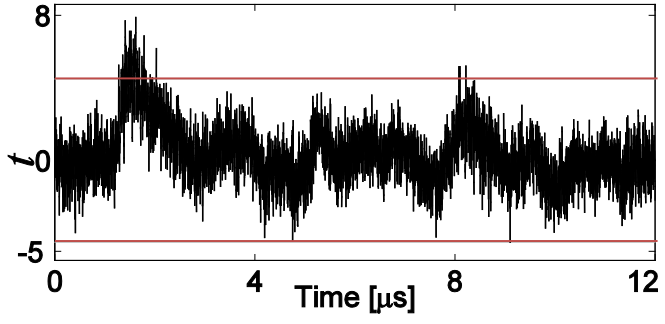
First-Order



Fourth-Order



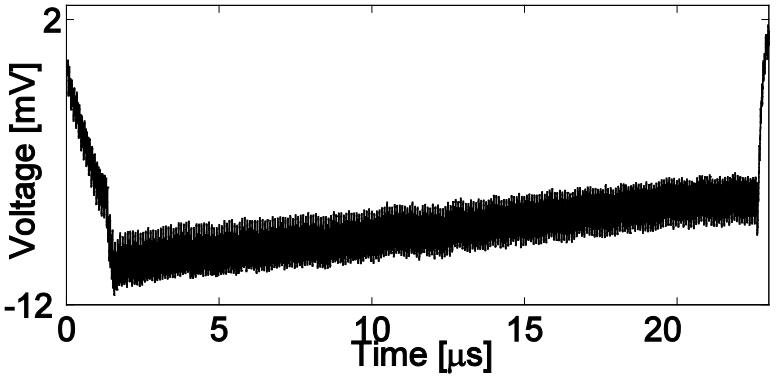
Second-Order



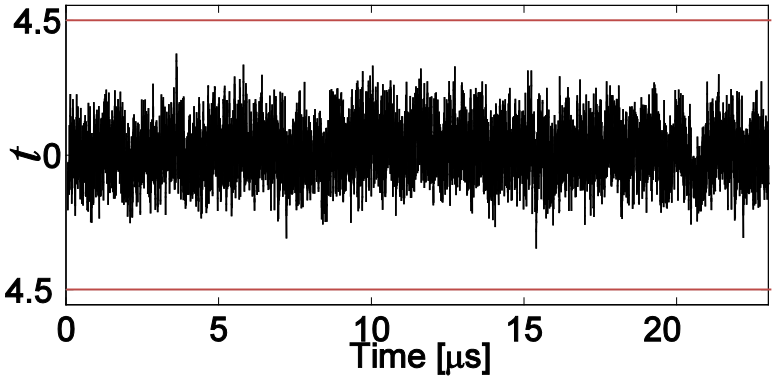
Fifth-Order

Evaluation

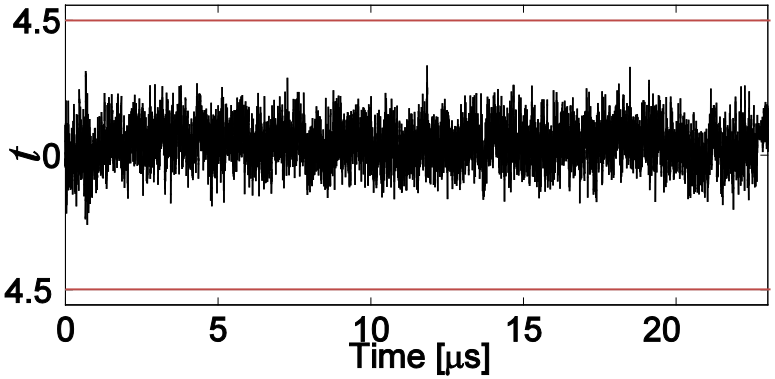
KATAN-1ST-G (1 Billion Traces)



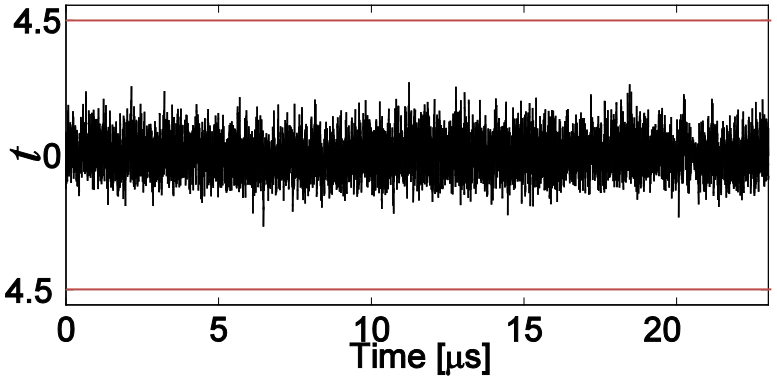
Sample Trace



Second-Order



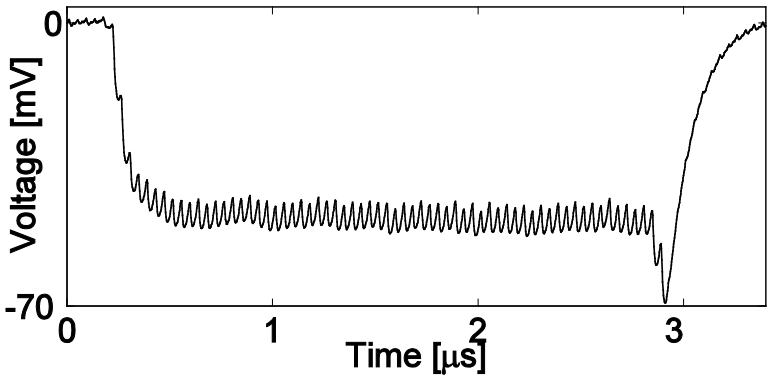
First-Order



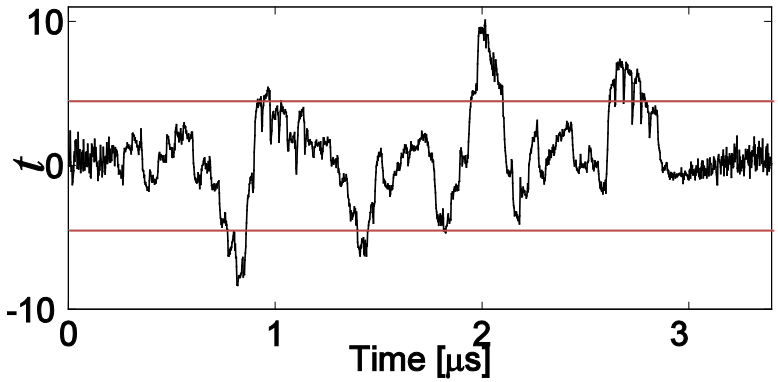
Third-Order

Evaluation

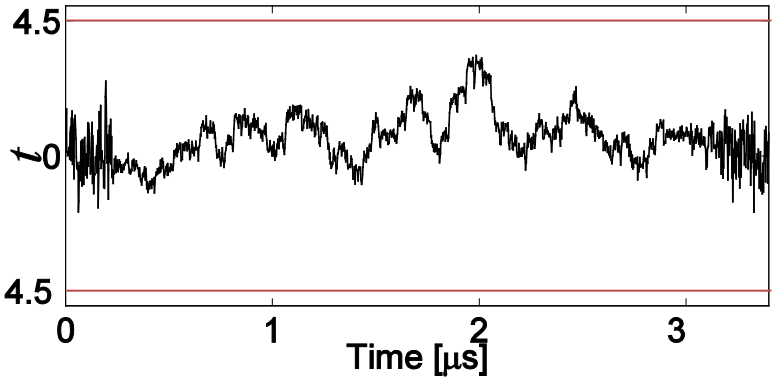
PRESENT-1ST (10 Million Traces)



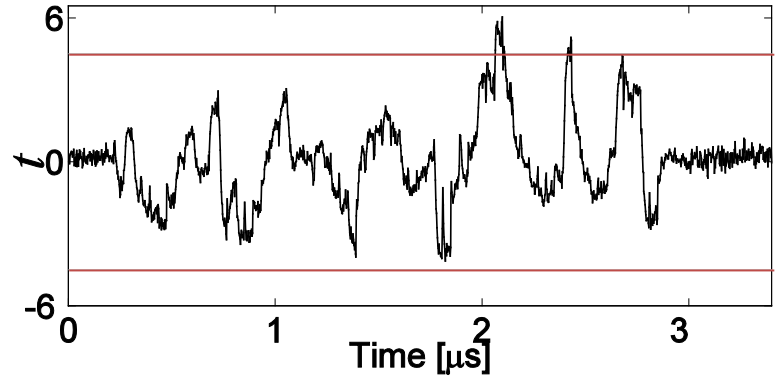
Sample Trace



Second-Order



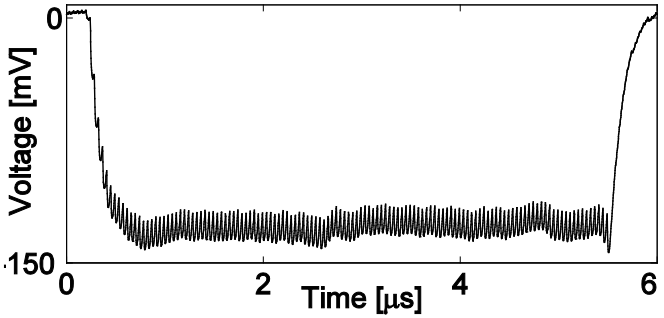
First-Order



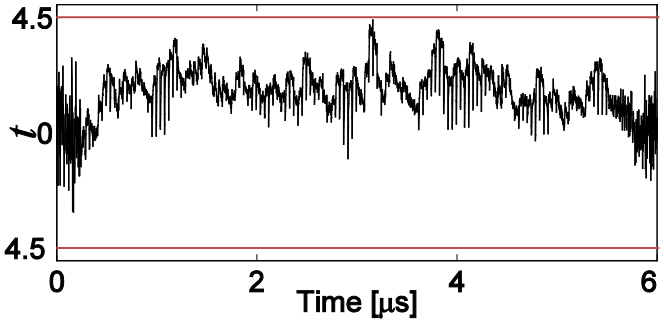
Third-Order

Evaluation

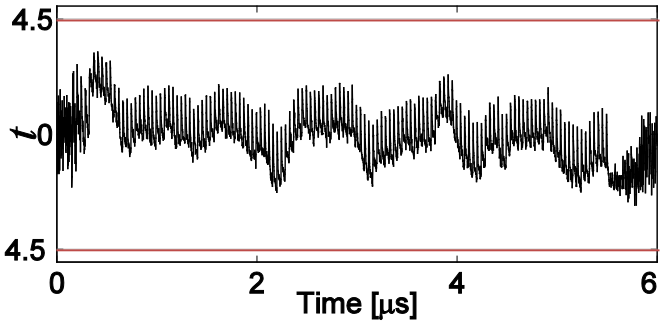
PRESENT-2ND (300 Million Traces)



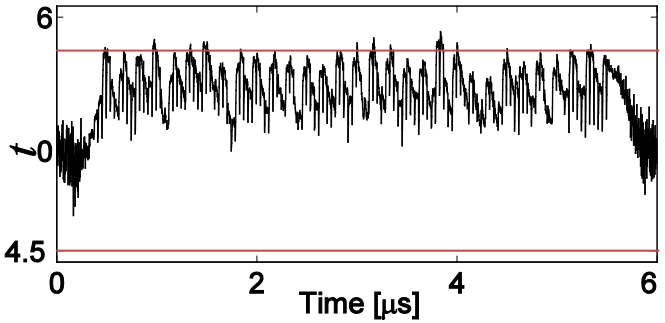
Sample Trace



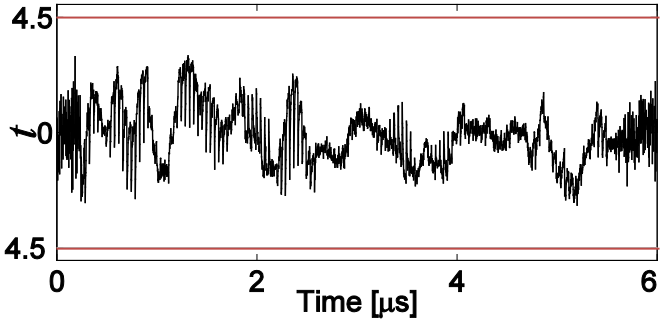
Third-Order



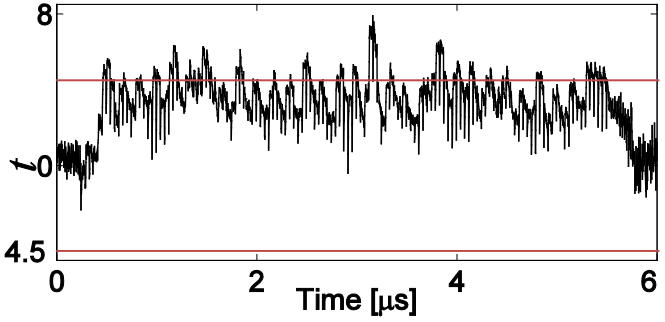
First-Order



Fourth-Order



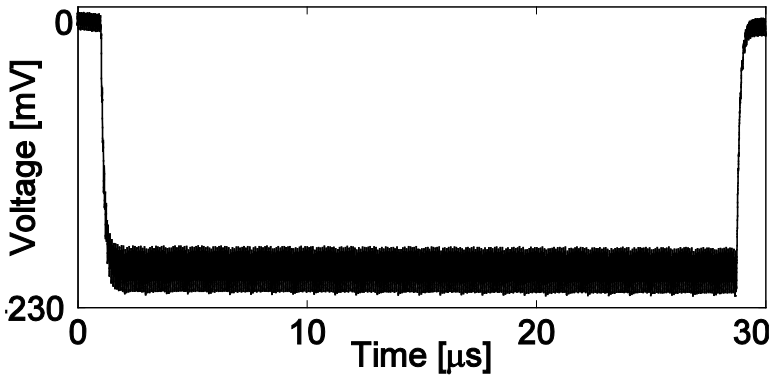
Second-Order



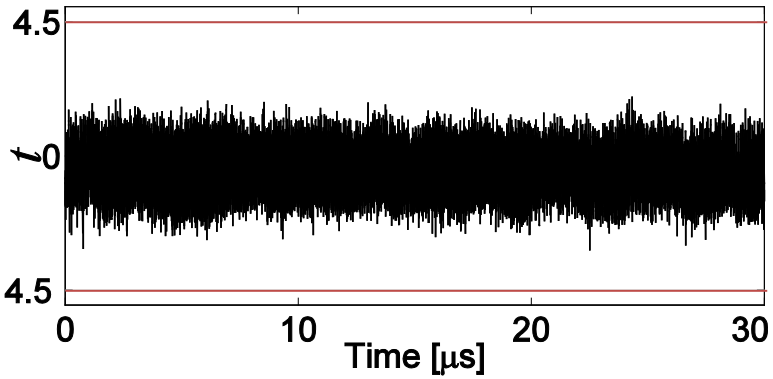
Fifth-Order

Evaluation

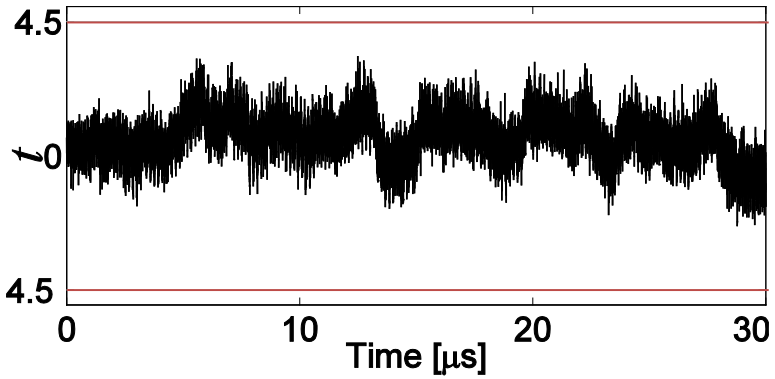
PRESENT-1ST-G (1 Billion Traces)



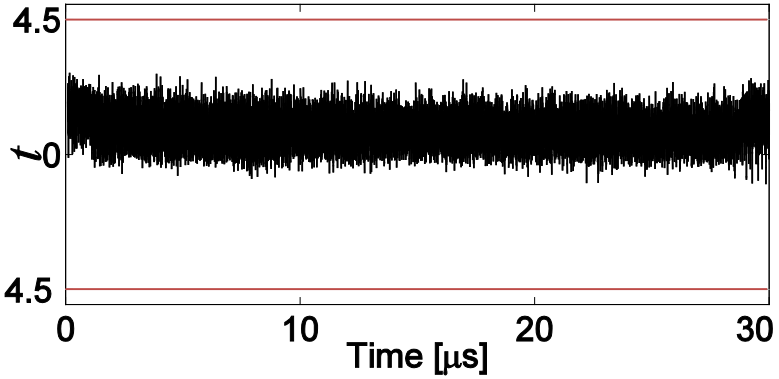
Sample Trace



Second-Order



First-Order



Third-Order

Conclusion

Conclusion

GliFreD + TI

Conclusion

GliFreD + TI

- Consumes more power

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- Consumes more power
  - Higher resource utilization

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  - Natural behavior of power equalization

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  - Design and application dependent
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- No provable resistance for higher-order
  - Still 1st-order secure
- Higher-order attacks practically infeasible
  - EM analysis
  - Fair to compare with 3rd-order TI

Thanks for Listening!

Any Questions?