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Success metric: An all-in-one criterion for comparing side-channel distinguishers

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Success Metric

An all-in-one criterion for comparing side-channel distinguishers

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Motivation & state-of-the art

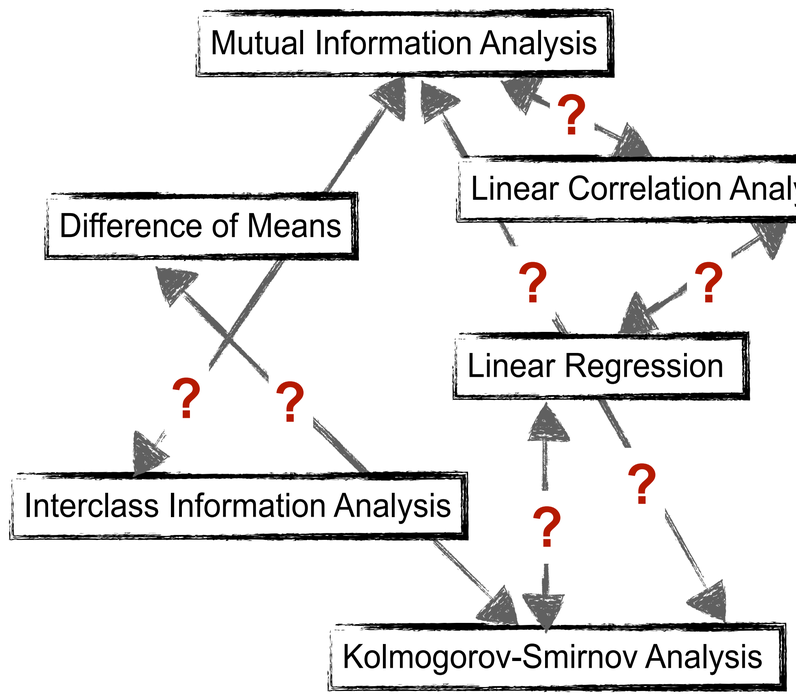
- Different side-channel distinguishers may have different efficiencies
- But their fair comparison is still a difficult task, since many factors come into play

Empirical Criteria

- Success rate (SR)
- Guessing entropy
- Displays the practical outcome
- Ad-hoc computation

Theoretical Criteria

- Relative distinguishing margin
- Displays the theoretical distinguishability
- Equivalent to practical outcome?



Success Metric

Notations

k Key guess, k^* Correct key

$\mathcal{D}(k)$ Distinguisher

Difference
$$\Delta(k^*,k) = \mathcal{D}(k^*) - \mathcal{D}(k)$$

Estimated difference
$$\widehat{\Delta}_m(k^*,k) = \widehat{\mathcal{D}}_m(k^*) - \widehat{\mathcal{D}}_m(k)$$

Estimation bias
$$\mathrm{EB}(k^*,k) = \mathbb{E}\{\widehat{\Delta}_m(k^*,k)\} - \Delta(k^*,k)$$

Estimation variance
$$\mathrm{EV}(k^*,k) = Var\{\widehat{\Delta}_m(k^*,k)\}$$

- ☑ Coincides with the empirical success rate
- ☑ Gives more insights on the parameters
- ☑ Depends on the number of measurements
- ☑ "Simple" closed form expression for any additive distinguisher
- Derived from the theoretical success rate through approximations

$$\mathrm{SM}(\mathcal{D},\widehat{\mathcal{D}}_m) = \min_{k\neq k^*} \frac{E\{\widehat{\Delta}_m(k^*,k)\}}{\sqrt{Var(\widehat{\Delta}_m(k^*,k))}}$$

Practical Evaluation

Correlation Power Analysis (CPA) | Mutual Information Analysis (MIA) histograms | Mutual Information Analysis (MIA) kernels | Kolmogorov-Smirnov Analysis (KSA)

Theoretical Criteria

Does **not** depend on
- the number of traces
- estimation method

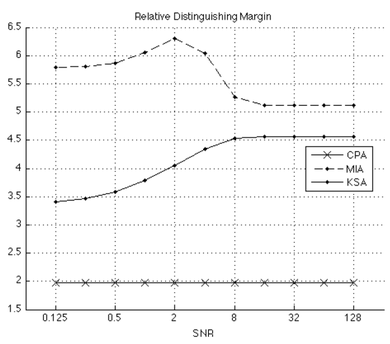


Figure 1

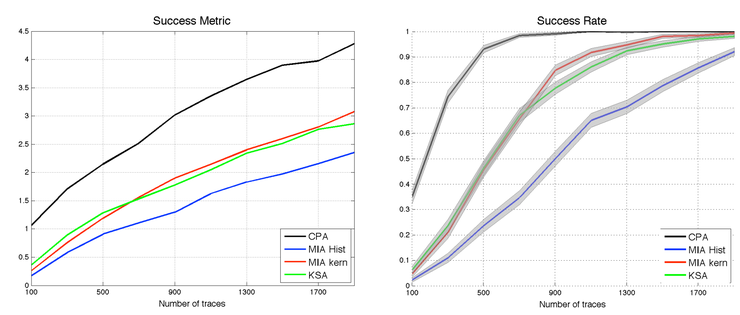
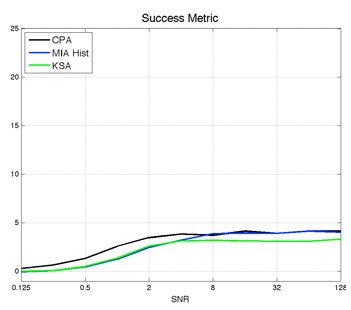


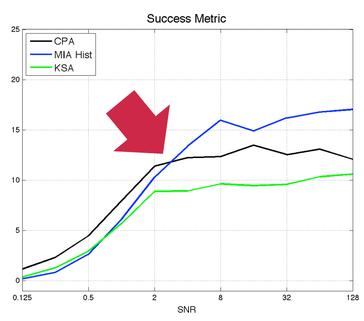
Figure 2

Success Metric

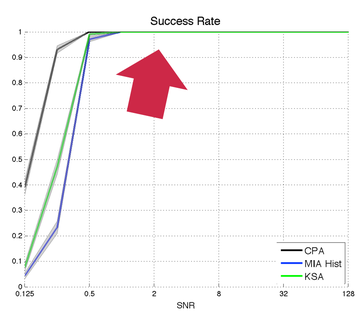
- Depends on the estimation method (Fig. 1)
- Coincides with the success rate (Fig. 1)
- Depends on the number of measurements (Fig. 2)
- More insights (Fig. 2)



Using 50 traces



Using 500 traces



Using 500 traces

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