



HAL
open science

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

Annelie Heuser, Sylvain Guilley, Olivier Rioul

► To cite this version:

Annelie Heuser, Sylvain Guilley, Olivier Rioul. Success metric: An all-in-one criterion for comparing side-channel distinguishers. Guido Bertoni; Jean-Sébastien Coron. 15th Workshop on Cryptographic Hardware and Embedded Systems (CHES 2013), Aug 2013, Santa Barbara, CA, United States. Springer, Lecture Notes in Computer Science, 8086, Cryptographic Hardware and Embedded Systems - CHES 2013 15th International Workshop, Santa Barbara, CA, USA, August 20-23, 2013. Proceedings. hal-02299990

HAL Id: hal-02299990

<https://telecom-paris.hal.science/hal-02299990>

Submitted on 20 Aug 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Motivation & state-of-the art

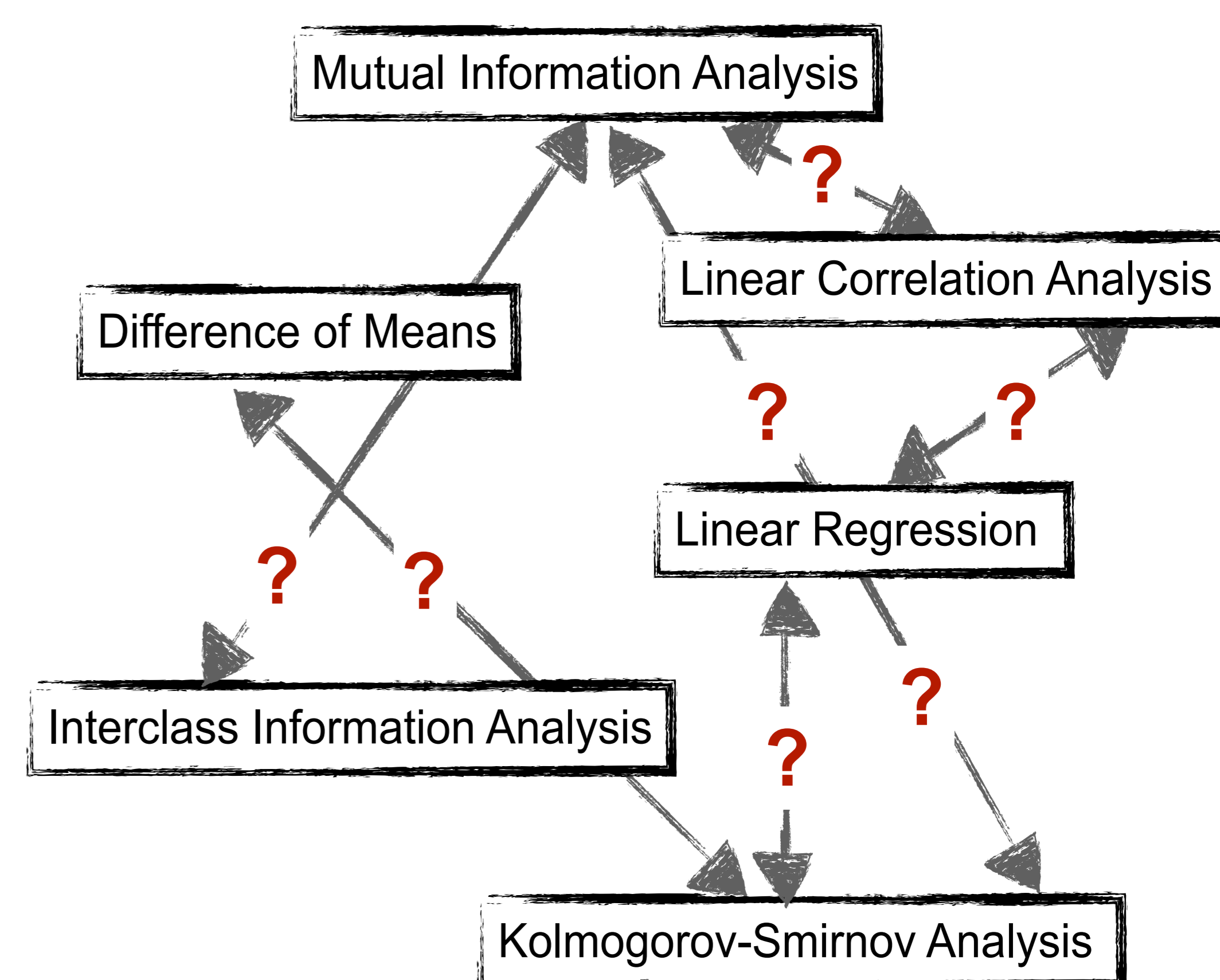
- Different side-channel distinguishers may have different efficiencies
- But their fair comparison is still a difficult task, since many factors come into play

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

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

Estimation bias

$$EB(k^*, k) = \mathbb{E}\{\hat{\Delta}_m(k^*, k)\} - \Delta(k^*, k)$$

Estimation variance

$$EV(k^*, k) = Var\{\hat{\Delta}_m(k^*, k)\}$$

- ✓ 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

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

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

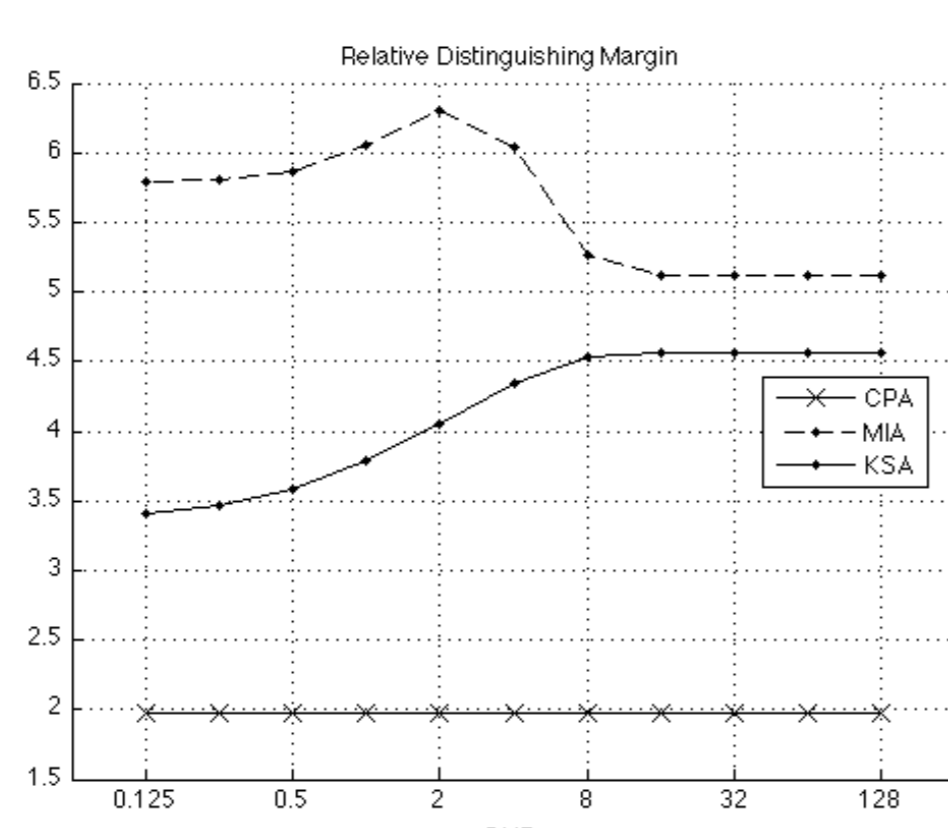


Figure 1

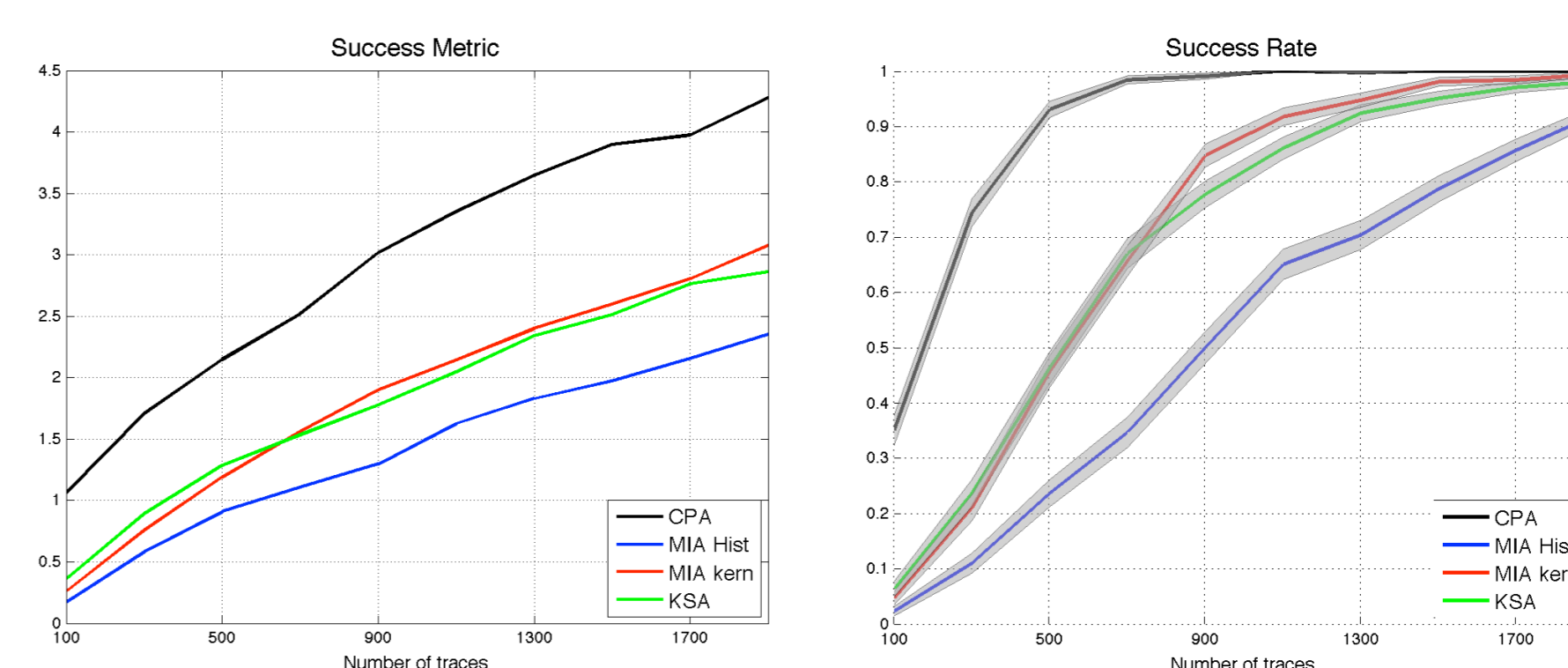
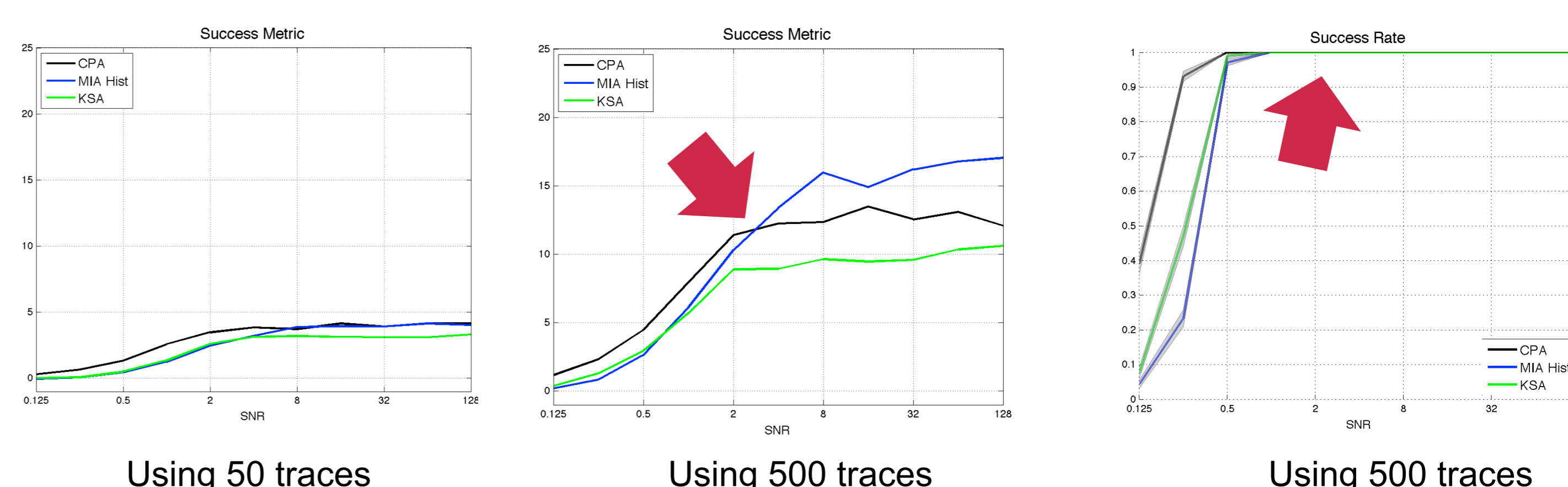


Figure 2



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)