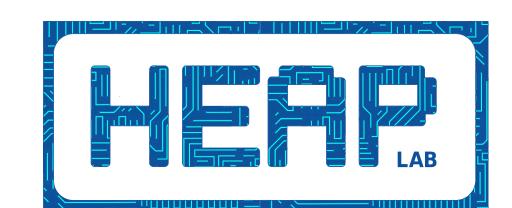


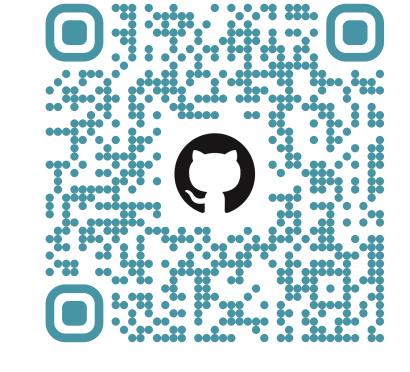
Towards Robust Deep-Learning Cryptographic Localization in Side-Channel Traces



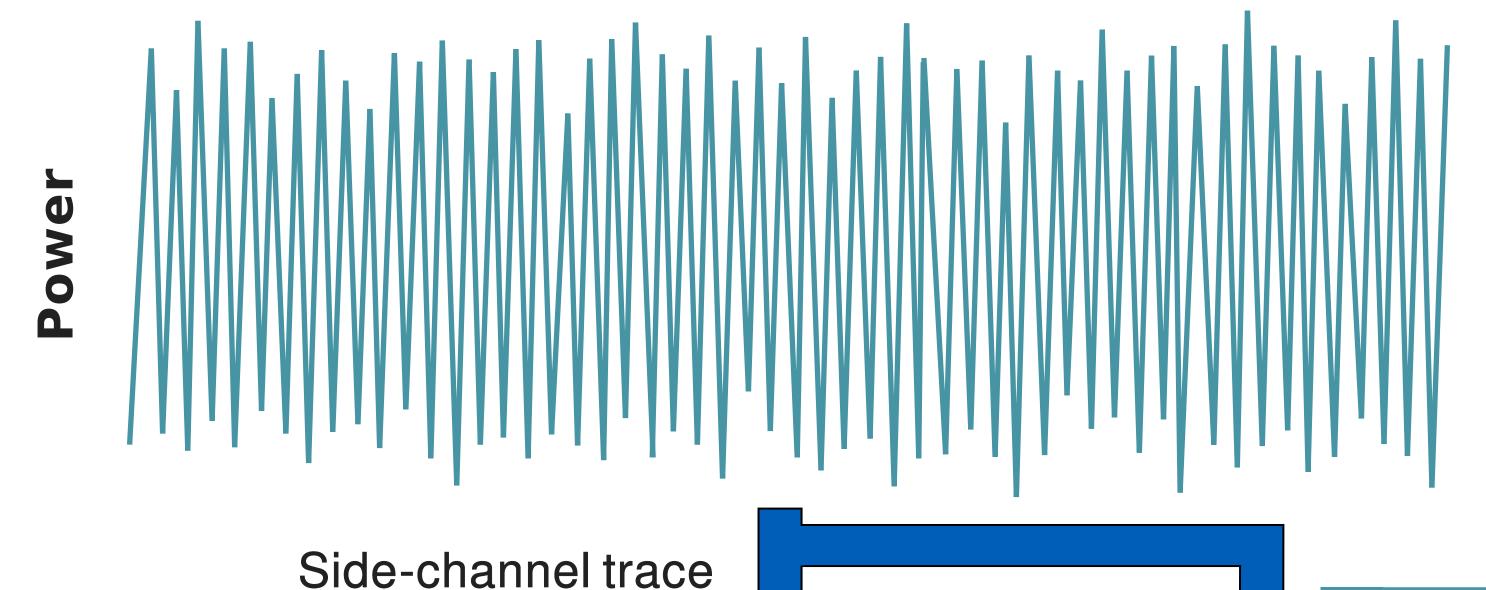
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A successful side-channel attack needs the attacker to:

- Locate in a side-channel trace the cryptographic operations (COs)
- Align in time the measured data



This work presents a deep-learning technique to accurately locate cryptographic operations in a side-channel trace, even in trace deformations. We validated our proposal through a successful attack against a variety of unprotected and protected cryptographic primitives that have been executed on an FPGA-implemented RISC-V CPU.



Slice the input into sub-windows and feed them to a CNN.

Depending on whether the window has been classified as the beginning of the CO or not, a higher or lower class score is assigned.

Clean the input into a square wave signal by comparing each sample with a threshold. Then, a median filter is applied to improve the accuracy further. This step returns the samples identifying the rising edges. Such points represent the beginning of each CO in the analyzed input trace.

Match the side-channel trace with the segmentation's samples.

Target the sub-byte intermediate of the AES chiper. A minor aggregation over time is used to fix the rough estimation of the beginning of the COs and to mitigate the presence of random delay.

Sliding Window Classification

Classification score for each window

Starting sample of

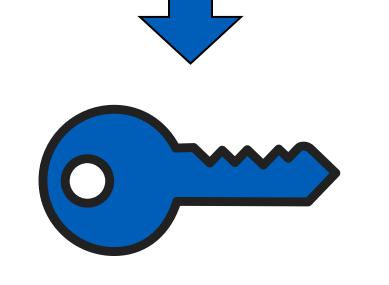
each CO

Segmentation

Individal COs' traces

Side-channel Attack

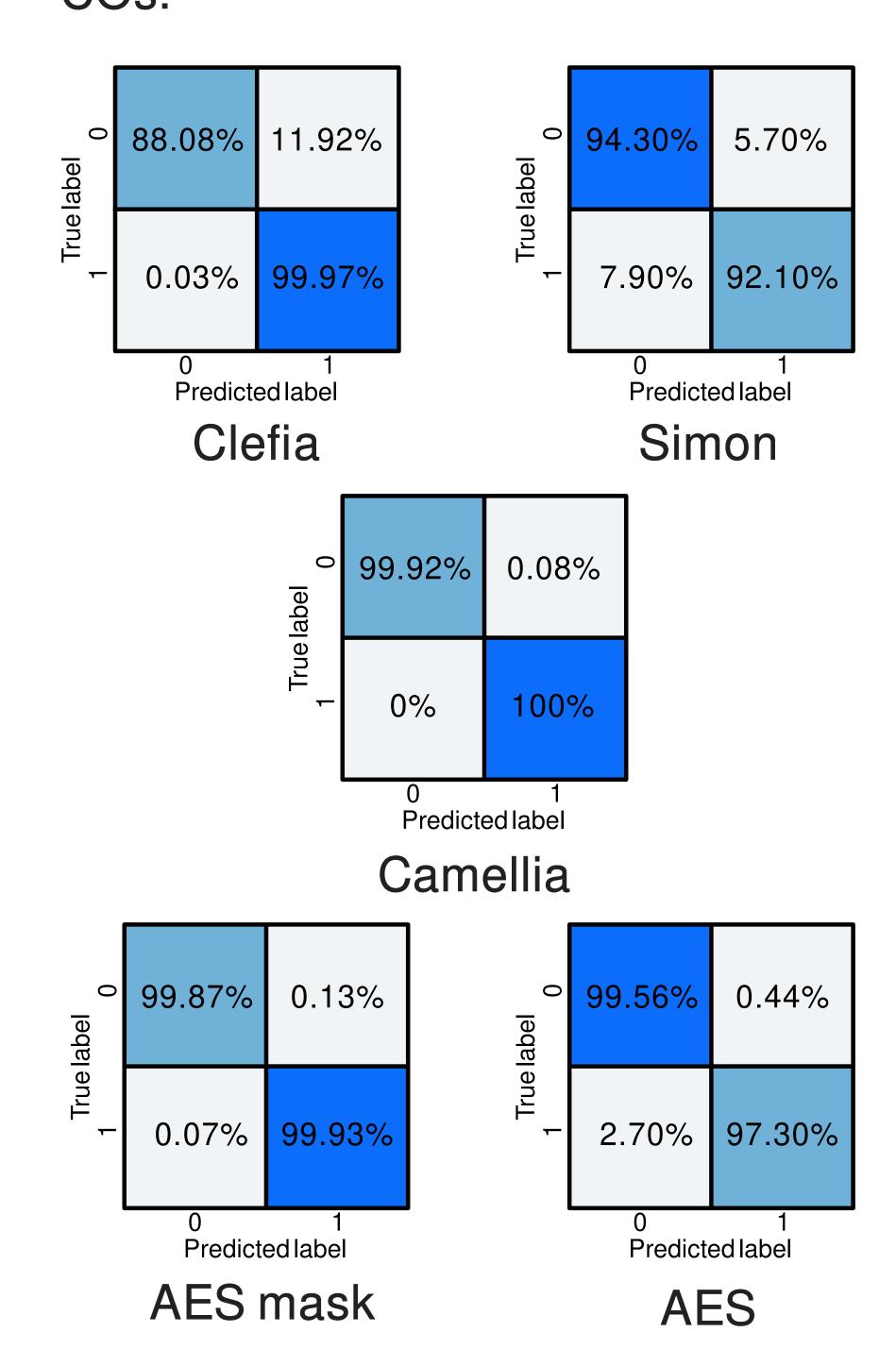
Alignment



Experimental Evaluation

- 5 COs: Clefia, Simon, Camellia, AES, AES mask
- Up to 2 (or 4) consecutive random delay instructions
- Interleave with noisy applications (or consecutive COs)

We are able to find 100% of the COs for every tested configuration. CPA is successful with less than 4000 COs.



References

[1] G. Chiari, D. Galli, F. Lattari, M. Matteucci and D. Zoni, "A Deep-Learning Technique to Locate Cryptographic Operations in Side-Channel Traces," 2024 Design, Automation & Test in Europe Conference & Exhibition (DATE), Valencia, Spain, 2024, pp. 1-6.
[2] D. Galli, A. Galimberti, W. Fornaciari, and D. Zoni, "On the effectiveness of true random number generators implemented on fpgas," in International

[2] D. Galli, A. Gallmberti, W. Fornaciari, and D. Zoni, "On the effectiveness of true random number generators implemented on fpgas," in International Conference on Embedded Computer Systems. Springer, 2022, pp. 315–326.

