Variational approach for attacking QPUFs

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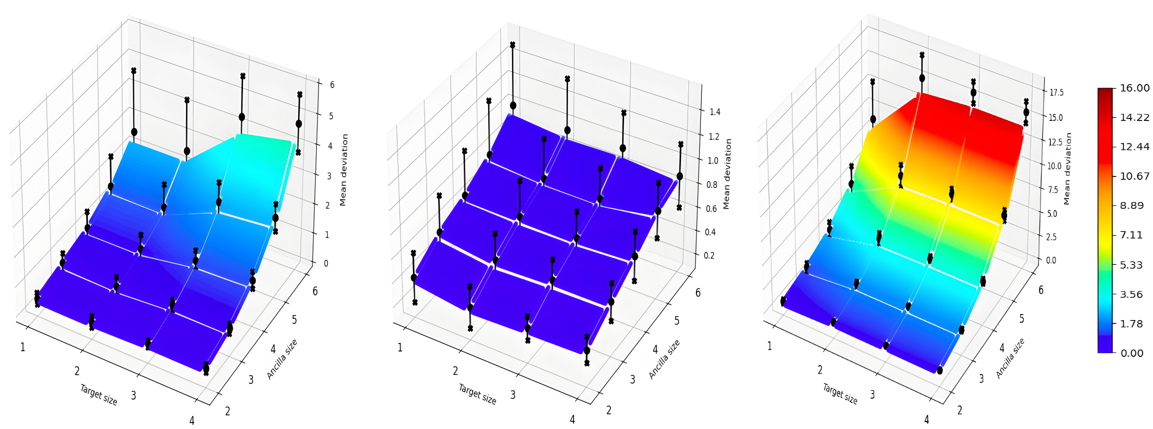
Utilizing the uncontrollable variations within manufacturing processes for secure authentication purposes can be already found in the works [1] and [2]. Later on, this idea was formalized by coining the term physical unclonable function (PUF) [3], leading to several proposals and patents in the subsequent years and establishing PUFs as a promising secure fingerprint. Nonetheless, classical PUFs lack fundamental security notions [4], and rely on an initial *unclonability assumption* of certain systems that may be afterwards found to be efficiently clonable [5].

In [6], a PUF design was derived by means of the quantum theory, aiming to tackle some of the stated vulnerabilities by exploiting the *no-cloning theorem* of quantum states. In the work [7], different flaws within such first quantum physical unclonable function (QPUF) were identified, and a new proposal trying to address such inconveniences was delivered: the Unkonown unitary QPUF. Finally, and being it the most recent contribution to the field at the time of writing this abstract, [8] harnessed the intrinsic random nature of quantum measurements in order to define a new QPUF model.

In this presentation we aim to

1) make the interconnection between PUFs and secure authentication comprehensible for the listeners to then present a significant contribution made to the field: modifying two existing algorithms in the state of the art of variational quantum tomography [9], [10], in order to substantially enhance their efficiency.
2) display how such modifications allowed for attacking a novel QPUF-based authentication scheme, obtaining a better performance than that one given by a randomized scheme (see Fig. 1).



(a) SVD forgery (b) User behaviour (c) Random forgery

Fig. 1: Performance of the singular value decomposition (SVD) attack. Each data point (black) corresponds to a different choice of intrinsic parameters of the simulated QPUF. Low heights are compatible with a high rate of successful authentications, while large heights correspond to denied attempts. **a** shows how our attack performs, as expected, worse than what an actual user would (**b**), but substantially better than uninformed forgeries (**c**), characterized by randomizing the attack algorithm.

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