Errata for:
Locally Computable UOWHF with Linear Shrinkage

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This is an errata for our Journal of Cryptology paper, "Locally Computable UOWHF with Linear Shrinkage" [2]. There is a gap in the proof of Theorem 4.1 that asserts that the collection $\mathcal{F}_{P,n,m}$ is δ-secure β-random target-collision resistant assuming the one-wayness and the pseudorandomness of the collection for related parameters. We currently do not know whether Theorem 4.1 (as stated in Section 4) holds.

The source of trouble is a miscalculation in the proof of Claim 4.4. Indeed, it is essentially claimed that for a random graph G and random input $x \in \{0,1\}^n$, any string $z \in \{0,1\}^n$ whose output $f_{G,P}(z) \in \{0,1\}^{2m}$ agrees with $f_{G,P}(x) \in \{0,1\}^{2m}$ on about $(1+\gamma)m$ locations, must be correlated with x. Unfortunately, this level of "output correlation" is not significant enough to guarantee the desired input correlation.

We note that Theorem 5.1 that transforms any δ-secure β-random target collision resistant collection to a target collision resistant collection while preserving constant locality and linear shrinkage, remains intact. Thus, one can construct a locally computable UOWHF with linear shrinkage based on the hypothesis that random local functions are δ-secure β-random target-collision resistant. Specifically, the main result of the paper can be based (via Theorem 5.1) on the following hypothesis.

Assumption 1. *For every constants $\varepsilon, \beta, \delta > 0$, there exists an integer d and a d-local predicate $P : \{0,1\}^d \to \{0,1\}$ such that the ensemble $\mathcal{F}_{P,n,(1-\varepsilon)n}$ is $o(1)$-secure β-random target-collision resistance, that is, every polynomial-time adversary $\mathcal{A}$ that is given a random local function $f \stackrel{R}{\leftarrow} \mathcal{F}_{P,n,(1-\varepsilon)n}$ and a random target $x \stackrel{R}{\leftarrow} \{0,1\}^n$, outputs $x' \in f^{-1}(f(x))$ which is βn-far from x with probability at most δ.*

In fact, the assumption seems plausible even for $\delta = o(1)$. We also mention that locally-computable functions with linear-shrinkage that achieve a stronger form of *collision-resistance* were constructed in [1] based on incomparable assumptions.

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References

[1] B. Applebaum, N. Haramaty, Y. Ishai, E. Kushilevitz, and V. Vaikuntanathan. Low-complexity cryptographic hash functions. In C. H. Papadimitriou, editor, *8th Innovations in Theoretical*

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[2] B. Applebaum and Y. Moses. Locally computable UOWHF with linear shrinkage. *J. Cryptol.*, 30(3):672–698, 2017.