An Annotated Bibliography of Practical Secure Computation

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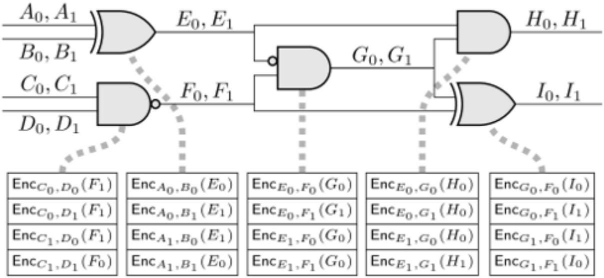
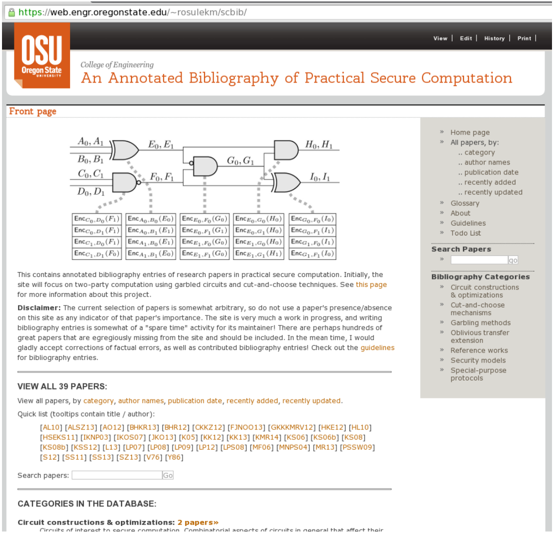


http://tinyurl.com/mpc-annotated



$\mathsf{Enc}_{C_0,D_0}(F_1)$	$\mathsf{Enc}_{A_0,B_0}(E_0)$	$\mathsf{Enc}_{E_0,F_0}(G_0)$	$\mathsf{Enc}_{E_0,G_0}(H_0)$	$\mathsf{Enc}_{G_0,F_0}(I_0)$
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This contains annotated bibliography entries of research papers in practical secure computation. Initially, the site will focus on two-party computation using garbled circuits and cut-and-choose techniques. See this page for more information about this project.

Disclaimer: The current selection of papers is somewhat arbitrary, so do not use a paper's presence/absence on this site as any indicator of that paper's importance. The site is very much a work in progress, and writing bibliography entries is somewhat of a "spare time" activity for its maintainer! There are perhaps hundreds of great papers that are egregiously missing from the site and should be included. In the mean time, I would gladly accept corrections of factual errors, as well as contributed bibliography entries! Check out the guidelines for bibliography entries.

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Bibliography Categories

- Circuit constructions & optimizations
- Cut-and-choose mechanisms
- Garbling methods
- Oblivious transfer extension
- Reference works
- Security models
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Who's it for?

- Anyone interested in "practical" aspects of MPC
- ... who knows enough crypto to have seen MPC definitions
- Your first-year PhD advisees

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What's there?

- Short summaries of 30 papers and counting
- Glossary

EXTENDING OBLIVIOUS TRANSFERS EFFICIENTLY

Yuval Ishai, Joe Kilian, Kobbi Nissim, Erez Petrank

CRYPTO 2003 [pdf] [bibtex]

Introduces the concept of **OT extension**. It is well known that oblivious transfer (OT) cannot be based on symmetric-key primitives alone (in a black-box way). Hence OT protocols necessarily rely on expensive public-key operations. OT extension is a method for obtaining a large number of effective OTs using only a small number of "base" OTs (depending only on the security parameter) plus symmetric-key operations, minimizing the cost of OT in an amortized sense.

The protocol achieves n instances of 1-out-of-2, ℓ-bit string OT, using only k instances of 1-out-of-2, n-bit string OT, where k is the security parameter. Note that it is trivial to extend the *bit length* of an OT by transfering (via a base OT) a length-k seed to a PRG and masking a longer message with the PRG output (this variant of OT extension is due to Beaver). Hence, the important parameter is that a small, fixed number k of OTs is extended to an arbitrarily larger number n of OTs.

1. The receiver chooses a random $n \times k$ matrix T of bits and a string $r \in \{0,1\}^n$ denoting his choice bits in the n logical OTs. The sender chooses random string $s \in \{0,1\}^k$.
2. Let $T_{*,j}$ denote the jth column of T (an n-bit string). The parties use the base OTs (in the opposite direction!), with the receiver providing messages $T_{*,j}$ and $T_{*,j} \oplus r$, and the sender providing choice bit s_j.
3. Let Q denote the matrix that the sender receives from these base OTs (received column-wise). Let $Q_{i,*}$ denote the ith row of Q. The important part of the protocol is that $Q_{i,*}$ is either $T_{i,*}$ or $T_{i,*} \oplus s$, depending on the receiver's choice bit r_i.
4. To execute the ith logical OT, the sender encrypts the two messages m_0, m_1 under one-time pads with keys $H(i \| Q_{i,*})$ and $H(i \| Q_{i,*} \oplus s)$, respectively, where H is a random oracle. Exactly one of these masks is $H(i \| T_{i,*})$, according to the receiver's choice bit, so the receiver can unmask his desired message. The other mask is $H(i \| T_{i,*} \oplus s)$, where s is unknown to the receiver.

Note that, besides the base OTs, the only other operations are calls to the random oracle H. The protocol is secure against semi-honest adversaries. A cut-and-choose technique can be used to provide security in the malicious setting.

For simplicity, the hash function H is assumed to be a random oracle. More concretely, the protocol requires that the joint distribution of

$$t_1, t_2, \ldots, t_n \text{ and } H(1\|t_1 \oplus s), H(2\|t_2 \oplus s), \ldots, H(n\|t_n \oplus s)$$

be psuedorandom where s is unknown. This security property is called **correlation-robustness.**

Categories:

OTExtension

Testimonials:

- *"Finally there is a website that can supervise my students for me."* — Payman Mohassel
- *"Will it count towards tenure?"* — My wife

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- Current focus on garbled-circuit 2PC only
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A plea for help:

- What papers are embarrassingly absent?
- Better yet, contribute summaries!
- What else would make this a helpful resource?