SaTC: I-C-U: AI-Enabled Recovery and Assurance of Semiconductor IP from SEM Images

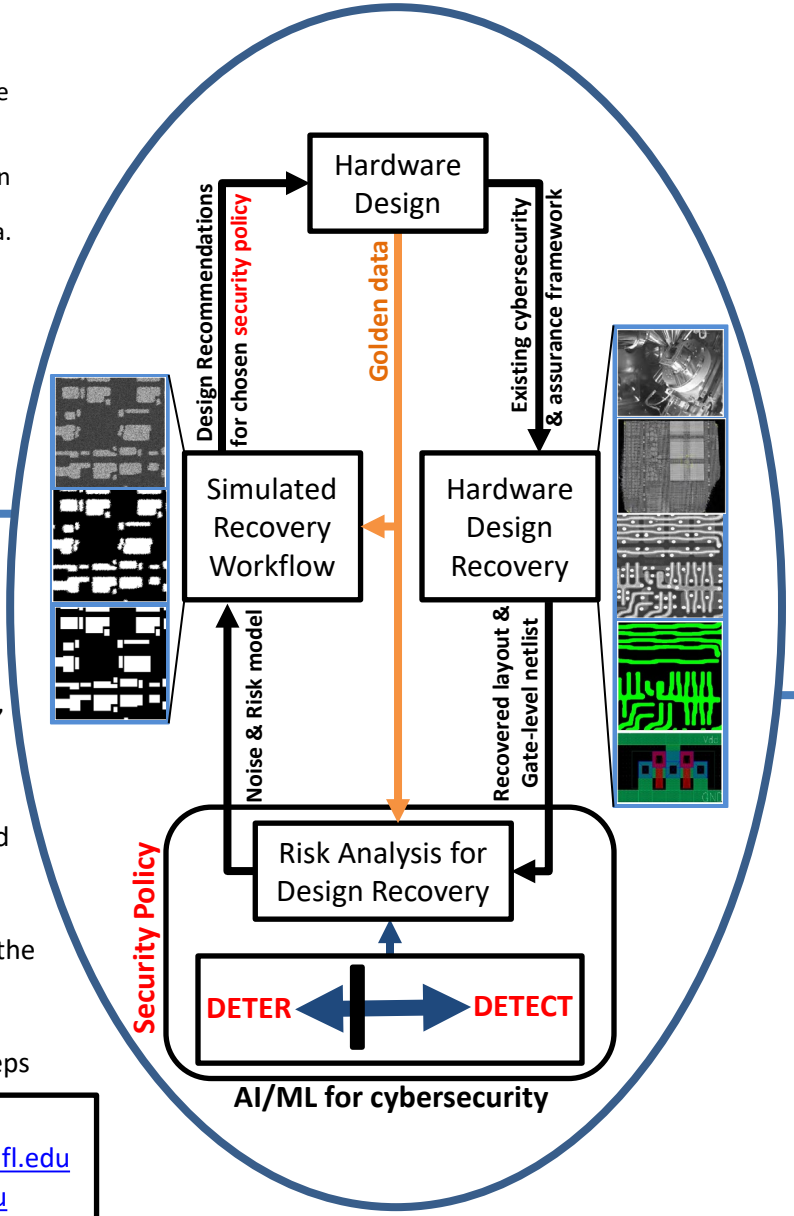
Challenges

Design recovery from SEM images for hardware assurance face several challenges:

- Scalability: Increasing logic gate counts in the IC increases imaging time, complexity and risk of accumulating errors in the acquired data.
- Lack of automation: Sample preparation and identification of logic gate libraries from a COTS layout require human assistance.
- Repeatability: Ad-hoc steps are widely used in sample preparation and image acquisition with varying success rates. This hinders the repeatability of the process.

Solutions

- Scalable automated design recovery workflow with AI-based fault-tolerant SEM image acquisition, segmentation, and gate-level netlist generation.
- Creation of resources to support development of data-driven simulated design recovery approaches via generation of synthetic images from real-world data, models that capture the noise introduced by IC sample preparation, deprocessing, and SEM imaging for repeatability in ad-hoc steps



Scientific Impacts

- Investigation of deep learning for automated design/layout recovery from SEM images, protection of proprietary semiconductor IP, and security policy compliant physical design.
- Development of risk analysis metrics for evaluating design recovery and deploying countermeasures during the physical design process that inhibit the attacker's ability to perform recovery and/or promote a defender's ability to detect IP infringement and hardware Trojans.
- Open-source SEM data sets and parameterizable layout-to-SEM simulation tools to develop and test design recovery routines.

Broader Impacts

- Utilize existing economically competitive global supply chain while guaranteeing trust on hardware devices for end users
- Privacy-preserving transforms for confidential knowledge transfer between microscopy, hardware assurance, computer vision communities and the semiconductor industry.
- Transition of developed approaches to industrial practice, dissemination of knowledge through coursework, training of labor force through outreach programs and involvement of students from underrepresented groups.

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