Compiler-based Countermeasure Against Fault Attacks
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The goal is to implement the instruction duplication technique as a countermeasure against Fault Attacks on an ARM 32-bit Microcontroller[1,2]. Operating inside a compiler allowed us to reduce the security overhead thanks to the flexibility and code transformations opportunities offered by compilers.

The user identifies the portions of the program to protect.

### Workflow

**Context**

The user identifies the portions of the program to protect.

**Instructions cannot be duplicated at the middle-end due to the SSA form**

**We only select instructions that are suitable for duplication**

**Registers are allocated in favor of duplication**

The register allocator tends to reduce register pressure: Reusing the allocated registers as soon as possible.

When the liveness intervals (L) of registers are disjoint: \( \{\text{L(vreg3)}\} \cap \{\text{L(vreg1)} \cdot \text{L(vreg2)}\} = \emptyset \)

We introduce a constraint: \( $dst \neq $src \)

**Instruction duplication before scheduling**

Before duplication

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Transformation</th>
<th>Duplication</th>
</tr>
</thead>
<tbody>
<tr>
<td>add ( r0, r1, r2 )</td>
<td>mov ( rx, r0 ) add ( r0, rx, r2 )</td>
<td>mov ( rx, r0 ) add ( r0, rx, r2 )</td>
</tr>
<tr>
<td>str ( r5, [r3, #4] )</td>
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</tr>
</tbody>
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After scheduling

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**Comparison with assembly approach**

AES 8-bit NIST on ARM Cortex-M3

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**References**

[1] Barenghi et al. Countermeasures against fault attacks on software implemented AES


**Legend**

\[ \checkmark \] Duplicable  \[ \times \] Not duplicable