FlexDFD: FLEXIBLE DFD HARDWARE FOR EFFICIENT POST-SILICON VALIDATION

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by

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Certificate

This is to certify that the thesis titled **FlexDFD: Flexible DFD Hardware for Efficient Post-Silicon Validation** being submitted by **C. Sandeep** for the award of **Doctor of Philosophy** in **Department of Computer Science and Engineering** is a record of bonafide work carried out by him under our guidance and supervision at the **Department of Computer Science and Engineering, Indian Institute of Technology Delhi**. The work presented in this thesis has not been submitted elsewhere, either in part or full, for the award of any other degree or diploma.

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C. Sandeep

Abstract

The increasing complexity of designs have rendered traditional pre-silicon verification strategies inadequate, as a result of which, an increasing number of functional errors are escaping into silicon. Post-silicon validation has emerged as a viable solution to this problem, where initial samples of the chip are tested in an environment that resembles its intended operating conditions. The foremost challenge during post-silicon validation is the limited visibility into the functioning of the chip. Two approaches have been proposed to tackle this: (i) capture atomic snapshots of the state at regular intervals, and (ii) record the behavior of a few internal signals continuously. The data thus captured through either of the approaches is transferred off-chip for further analysis to detect the presence of bugs. Such off-chip transfers are usually over a low bandwidth debug link, which makes them extremely time-consuming.

In this thesis, we propose techniques to minimize the time taken for such transfers under both the aforementioned approaches by discarding as much redundant or irrelevant data as is possible in order to reduce the volume of data to be transferred off-chip. Under the first approach, we achieve this by only transferring the changes to the state since the previous snapshot. We propose a novel hardware structure called Interval Table *that stores the information on updates to the state using negligible area. Under the second approach, we propose novel hardware to summarize the behavior of the internal signals by discarding the information that is irrelevant to debug the observed error.*

Further, instead of disabling the on-chip debug hardware, we propose to reuse them in-field in ways that benefit the target applications. We demonstrate this through an example where the proposed summarizer is reprogrammed to function as a jitter unit that helps mitigate operating system jitter.

संक्षेप

डिजाइनों की बढ़ती जटिलता के कारण पारंपरिक पूर्व-सिलिकॉन सत्यापन रणनीति अपर्याप्त है, जिसके परिणामस्वरूप, सिलिकॉन में कार्यात्मक त्रुटियों की संख्या बढ़ रही हैं। पोस्ट-सिलिकॉन सत्यापन इस समस्या का एक व्यवहार्य समाधान के रूप में उभरा है, जहां चिप के शुरुआती नमूनों का परीक्षण एक ऐसे वातावरण में किया जाता है, जो इसकी प्रयुक्त परिस्थितियों के अनुरूप होता है। पोस्ट-सिलिकॉन सत्यापन के दौरान सबसे बड़ी चुनौती चिप की कार्य पद्धति में सीमित दृश्यता है। इस से निपटने के लिए दो तरीकों का प्रस्ताव दिया गया है: (i) नियमित अंतराल पर चिप की आंतरिक अवस्था को कैप्चर करना, और (ii) लगातार कुछ आंतरिक संकेतों का व्यवहार रिकॉर्ड करना। इस तरह से लिया डेटा, बग की उपस्थिति का पता लगाने के लिए आगे विश्लेषण के लिए ऑफ-चिप स्थानांतरित किया जाता है। ऐसे ऑफ-चिप स्थानान्तरण आमतौर पर कम बैंडविड्थ वाले डीबग लिंक के दरिये होता हैं, जो इसे समय-उपभोक्ता बना देता है।

इस थीसिस में, हम पूर्वकथित तरीकों के तहत डेटा को ऑफ-चिप स्थानांतरित करने के लिए लिया गया समय कम करने की तकनीक का प्रस्ताव करते हैं। पहले तकनीक के अंतर्गत, हम केवल पिछले स्नैपशॉट के बाद से आंतरिक अवस्था में हुई परिवर्तनों को स्थानांतरित करते हैं। हम 'अंतराल तालिका' नामक एक नया हार्डवेयर संरचना का प्रस्ताव करते हैं जो नगण्य क्षेत्र का उपयोग करते हुए आंतरिक अवस्था में हुई परिवर्तनों की जानकारी संग्रहीत करता है। दूसरे तकनीक के तहत, हम उस सूचना को छोड़कर आंतरिक संकेतों के व्यवहार को सारांशित करने के लिए नया हार्डवेयर का प्रस्ताव देते हैं जो त्रुटि को डिबग करने के लिए अनुपयोगी है।

इसके अलावा, ऑन-चिप डिबग हार्डवेयर को अक्षम करने के बजाय, हम इन्को दोबारा इन-फील्ड उपयोग करने का नये तरीकों का प्रस्ताव करते हैं जिससे अनुप्रयोगों को लाभ पहुंचाती हैं। हम इसे एक उदाहरण के माध्यम से दर्शाते हैं।

Contents

List of Figures

List of Tables