Optimum satisfaction of conflicting requirements in aerospace systems design

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The high complexity of the designs related with the new generation of Application Specific Integrated Circuits (ASICs and FPGAs) requires system level methodologies for its design and verification [1].

In the field of SOCs design, the use of HW-SW co-design has become essential [2,3,4]. At the first stages of this process several implementation alternatives are evaluated by HW-SW metrics estimation (area, performance, power, etc) in order to reduce the design space [5].

Much has been written about different techniques for this estimation [6,7,8,9,10]. However, little has been said about how to solve the different conflicts associated with that metrics, and not too much about how to choose between the different implementation alternatives when those metrics have to satisfy multiple objectives.

These objectives use to be interdependent and conflictive between them and frequently the degree of conflict depends on the relationship between the properties of the inputs and the outputs of the System Under Development (SUD). Moreover, the performance requirements related with this properties use to be imprecise.

The rules of good requirements engineering demand that all the requirements be precise [17]. If we consider that a requirement is precise only when it can have two states: satisfied or non-satisfied, these rules preclude the possibility of the optimum trade-offs that can only be obtained by evaluating a detailed model of its imprecision.

Having imprecise requirements domains and from each one of them a mapping to a satisfaction degree [11], the best balance in the trade-offs between conflictive requirements can be obtained.

The metrics related with the properties of several candidates can be obtained in all the operating conditions by model co-simulation, in order to choose the best of them. For that, a Test-Bench (TB) has to be used as a co-simulation environment.

HW-SW co-design techniques demand for fast modeling of the embedded software plus the hardware platform where it will run.

Transaction Level TBs [15,16,19] have the advantage that can be implemented fast, and can also be reused along all the design refinement process.

The methodology we will describe here combines FL (for optimum conflict resolution) [12,20] and TLM (for the system and its environment (TB) modeling) in a co-design context. It allows to choose the best candidate between several designs and to

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produce a reusable platform for the tracing of the system's performance along all the design/verification refinement process.

In this work, we discuss the proposed methodology and present a case study for the evaluation of the design of the front end of a spacecraft nuclear power system monitor [13,14].

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