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Application Note for SMT6096

Abstract

HW/SW Codesign of Digital Signal Processing Systems is as easy as ...

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Revision History

Issue	Changes Made	Date	Initials
1.0	New Document	15/01/2007	SM

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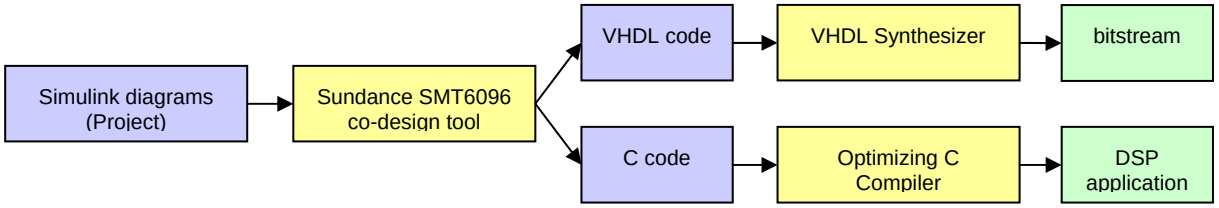
1 HW/SW Codesign of DSP Systems is as easy as...

Rapid prototyping systems are usually composed of CPUs, FPGAs, ADCs and DACs. Developing Digital Signal Processing Systems (DSPS) on such systems therefore requires designing a number of SW, digital HW and analog HW subsystems which tightly interact. Design validation requires simulating the interacting subsystems as a whole, therefore it requires appropriate cosimulation and codesign techniques.

SMT6096 is an innovative HW/SW codesign tool based on TheMathworks' Simulink™ and MATLAB™ simulation environments which allows to easily convert a Simulink diagram into a hybrid DSPS based on Sundance SMT8096 SDR kit and to cosimulate all subsystems (HW+SW+analog) together with the ease offered by the Simulink™ environment.

The user simply has to describe his/her algorithm by means of a number of blocks which are functionally identical to those from the Simulink library (math and logical operators, non-linear and trigonometric functions, vector and matrix operations, (de)modulators, etc.), although they are capable to accurately simulate the effects of their SW, digital or analog HW implementation. In such a way, the user **co-designs** and **co-simulates** the system as a whole, independently on the chosen implementation(s).

As soon as the DSPS has been co-designed, co-simulated and tuned (by means of the powerful MATLAB capabilities), the DSPS can automatically be converted into C code (for all SW blocks) and VHDL code (for all HW blocks), including HW/SW interfaces (which are converted into both C and VHDL subblocks). The generated codes are then automatically compiled (by means of Texas Instrument's Code Composer Studio™ and Xilinx' ISE Foundation™, respectively) and downloaded into the DSP program memory and the FPGA configuration memory.



More details

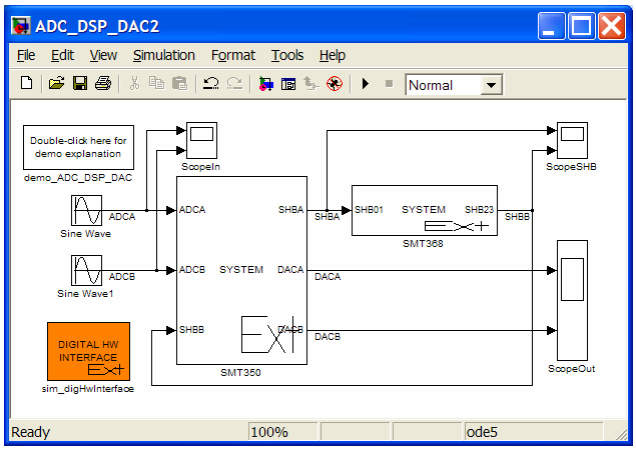
2 Zoom on in HW/SW Co-simulation and Co-design

HW/SW codesign is an innovative approach to the design of high-performance and low-cost systems which approaches system design at a very high level. An algorithm is described in terms of general purpose functions (mathematical, logical, signal and video processing, etc.) without minding, at the very first design phase, about their implementation.

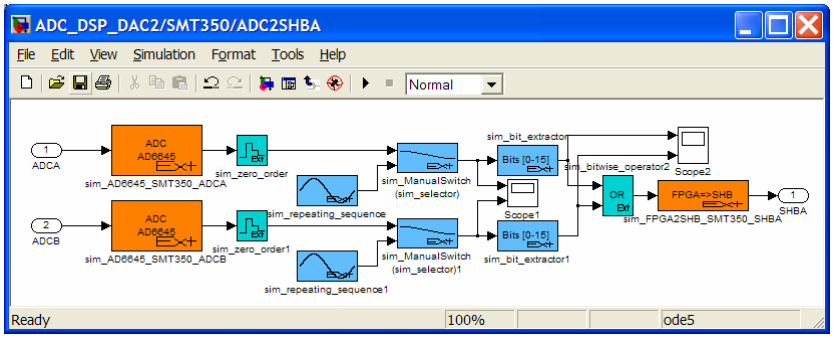
The algorithm is first validated in conjunction with the environment within which it has to operate (e.g. receiving images in real-time from a camera and sending results to a monitor, or analog signals from an external signal generator).

An implementation (either analog or digital or software) is then associated with each subsystem and the system is quickly simulated again to assess the effects of implementation details on the algorithm. At this stage, implementation details (e.g. resolution, SW data type, etc.) are associated with each block and their effects evaluated, on the whole system, by simulation. MATLAB tools can be used to optimize and tune all implementation details.

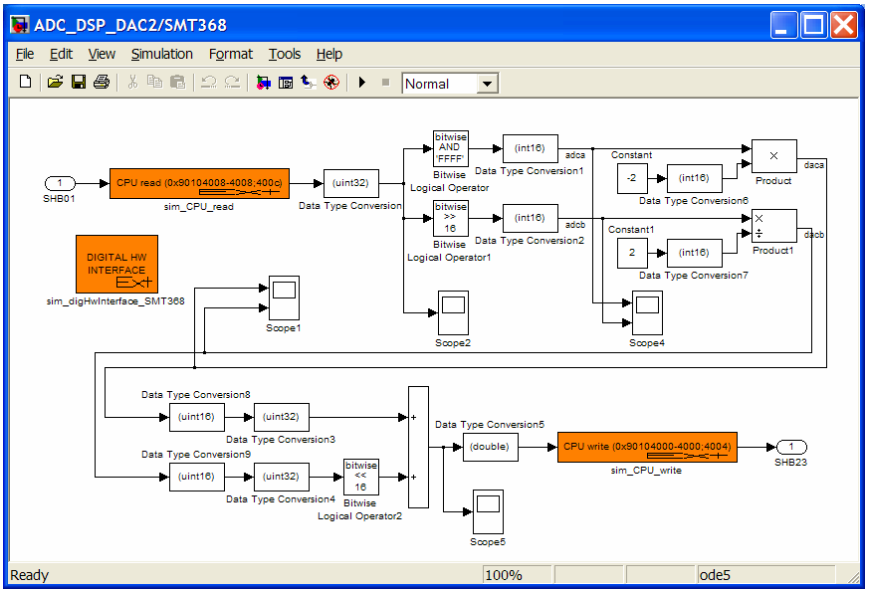
As soon as the algorithm has been validated and implementation parameters have been optimized, the system can automatically generate C code (for the SW blocks) and VHDL code (for the HW blocks), which are processed by the appropriate C and VHDL compiler and then downloaded onto the chosen Sundance board (e.g. the **SMT8096** Software Defined Radio Kit), where the system is eventually tested.



The **SMT350** board (FPGA+ADC+DAC) interconnected with the **SMT368** board in the **SMT8096** Software Defined Radio Kit via Sundance **SHB** buses.



Signal acquisition on two ADCs and processing on the Virtex-4 on the **SMT350** board



Software processing on the TMS320 DSP in the **SMT368** board

3 Requirements

The MathWorks:

- MATLAB® R14 (which includes Simulink® V7.0) or later
- Real Time Workshop

Texas Instruments:

- TI Code Composer Studio® 3.1

Sundance:

- SMT8096

Xilinx:

- Xilinx ISE® 6.2 Foundation or above