"CORA-MBAD FOR ZYNQ 7000: MODEL BASED DEFINITION AND IMPLEMENTATION OF RECONFIGURABLE COTS AVIONICS"

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The CoRA-MBAD ("Compact Reconfigurable Avionic - Model Based Avionic Design") activity is aimed at developing a HW/SW co-design toolchain providing functionality to easily deploy functional blocks in either HW or SW implementations, from identical source models. The toolchain is based on the TASTE toolset [1] and targets a GR740 general-purpose processor coupled to a BRAVE reconfigurable FPGA. In this follow up activity, "CoRA-MBAD for ZynQ 7000", we adapt said toolchain to a ZynQ 7000 SoC target, motivated by low-cost missions that will use platforms based on COTS components such as this Xilinx SoC. This SoC includes a dual-core ARM processor and a large reconfigurable FPGA.

The toolchain implements the automatic transformation of models (Matlab/Simulink) into Software (C) and Hardware (VHDL) source files, and the subsequent automatic generation of the needed consistent communication interfaces supporting the exchange of commands and data between functional blocks executed on the processor system (PS) and on the programming logic (PL) sides of the Xilinx SoC. This required adding support for the ARM Cortex A9 development toolchain (RTEMS ARM support), the Xilinx FPGA development toolchain (Vivado), and for the Advanced eXtensible Interface (AXI) communication interface for on-chip communication.

The toolchain was adapted to leverage the latest TASTE enhancements. TASTE's Kazoo tool [2] was adapted to build the modeled systems with increased performance, efficiently producing derived models, code and scripts using templates processing.

The MBAD System relies as well on autocoding from Matlab/Simulink to C performed by MathWorks Embedded Coder [3] and on high-level synthesis of C code performed by Bambu [4]. Both TASTE and Bambu are open-source SW tools. Bambu is FPGA vendor independent, hence it can be used with minor adaptations needed for each FPGA specific component.

The demonstrator use case is based on a computer vision algorithm that is used for vision-based navigation.

The presentation will highlight the toolchain's SW/HW interface generation consistency guarantees as well as the main challenges faced and opportunities identified.

[1] [Online] "TASTE," European Space Agency, Available at: https://taste.tools.
[2] [Online]. Available at: http://taste.tuxfamily.org/wiki/index.php?title=Kazoo.
[3] [Online]. Available at: https://www.mathworks.com/products/embedded-coder.html.
[4] [Online]. P. d. Milano, "PandA," Available at: https://panda.dei.polimi.it/.