



Introduction

Today, preserving a competitive advantage requires bold products. Product differentiation drives product innovations, mainly composed of advanced algorithms. Due to ever-increasing market requirements, an advanced algorithm requires breakthrough technologies to achieve a profitable product. In fast-growing industries such as the “Internet of Things” and data centers, a field-programmable gate array (FPGA) is considered the one-stop technology enabling companies to bring innovative products to the market more quickly.

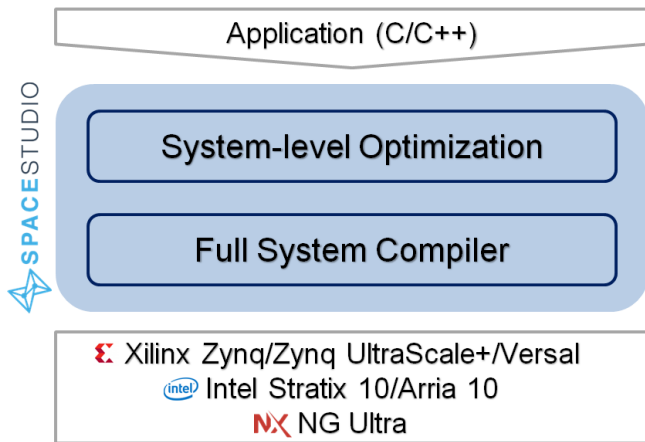
Advanced algorithms, the bedrock of a company’s intellectual property, are designed by software developers. To offer a truly innovative product, developers must focus solely on the design of the advanced algorithm without being impeded by the underlying technology. FPGA technology is notably hard to program and requires years of experience for hardware designers to master. Current workforce trends show that software developers outnumber hardware designers. This ever-growing number is shifting product innovation from hardware developers to software developers.

To take full advantage of the benefits of FPGA technology, software developers require a design flow that offers joint support to both hardware and software. This flow must be simple enough to warrant its use and adoption by software developers. The flow must also provide insightful feedback about the optimization choices available to achieve the required product differentiation.

Founded in 2011, Space Codesign Systems Inc. is a technology transfer spin-out from Polytechnic Montreal, Canada, located in Montreal, Quebec, Canada, and in Paris, France. Space Codesign Systems is a software publisher whose flagship product, SpaceStudio, is a development environment for software developers that eases the design flow of advanced algorithms targeting FPGA technology without the inherent complexity of FPGA. SpaceStudio covers the algorithm creation phase, algorithm and architecture optimization phase and full system compilation on either FPGA vendor (e.g., Xilinx, Intel, NanoXplore).

Introducing the SpaceStudio development environment

SpaceStudio is a development environment that eases the design flow of algorithms for a multiprocessor system-on-chip coupled with an FPGA that targets Xilinx Zynq/Zynq UltraScale+/Versal, Intel Stratix 10/Arria 10 and NanoXplore NG-Ultra. SpaceStudio takes algorithms written in C/C++, provides system-level optimization and generates the full system (software compilation, connectivity and hardware accelerator compilation) to be executed on a physical board.

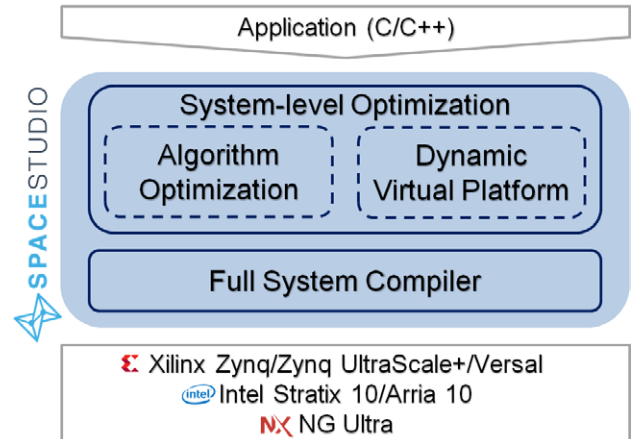


System-level optimization shortens the design cycle by optimizing the algorithm using an accurate simulation tailored to the algorithm. The full system compiler compiles the full system by taking away the FPGA complexity while retaining control over key decisions. SpaceStudio enables technology agnosticism by compiling the full system according to either Xilinx, Intel or NanoXplore FPGA architecture.

SpaceStudio is used to speed up algorithms, assess system requirements, handle all error-prone manipulations and ease the complete design flow for the software developer.

System-level Optimization

System-level optimization happens in the simulation to achieve algorithm acceleration. The software developer iterates in this phase until the requirements are satisfied. SpaceStudio provides an accurate processor model (e.g., ARM A9, A53, A72, R5, Microblaze and NIOS II) running either on Linux, RTEMS, FreeRTOS, μ C/OS-II or on bare-metal.



The software developer accelerates the algorithm by moving pieces of C/C++ code (functions, loops, etc.) as hardware accelerators by leveraging SpaceStudio's accelerated communication API.

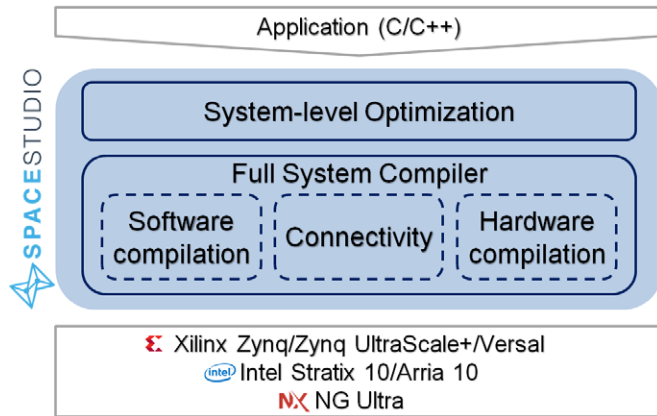
SpaceStudio analyzes the partitioning of the algorithm and generates a dynamic virtual platform. This platform executes the simulated FPGA architecture, where the offloaded C/C++ function becomes a hardware accelerator inside the FPGA fabric without rewriting the algorithm. The dynamic virtual platform generation is completely handled by SpaceStudio and is an accurate representation of the final system.

The dynamic virtual platform provides an extensive, nonintrusive monitoring infrastructure that provides qualitative insights about the performance of the algorithm (e.g., algorithm throughput, FPGA resource utilization).



Full System Compiler

The full system compiler compiles an optimized system (obtained from the system-level optimization phase) to a physical board. The optimized system is composed of compiled software binary, synthesized hardware accelerators along with synthesized connectivity. By leveraging existing low-level tools, SpaceStudio automates the various steps required to compile the hardware- and software-optimized algorithm.



SpaceStudio cross-compile the algorithm running on the processors, drivers, bootloaders and operating system. SpaceStudio calls high-level synthesis (HLS) tools (e.g., Xilinx Vitis HLS, Intel HLS Compiler or Siemens Catapult HLS) for the hardware accelerator. The connectivity required (e.g., interconnect, adapters, FIFO, DMA, etc.) to perform memory transfer between software tasks and the hardware accelerator is automatically added.

When the software, hardware and connectivity are integrated into the system, SpaceStudio generates the bitstream by calling the implementation tools (e.g., Xilinx Vivado, Intel Quartus Prime or NanoXplore Impulse) for final and complete system generation. The output of this phase is an execution of the algorithm on the physical board.



Conclusion

SpaceStudio is a versatile development environment for software developers that focuses on optimizing algorithms by abstracting cumbersome FPGA details.

SpaceStudio streamlines the FPGA design process by automating tasks from simulation to implementation. Its user-friendly interface and "push-button" compilation capabilities allow developers to focus on algorithm optimization without being bogged down by low-level FPGA details. This approach maximizes the benefits of FPGA technology, making it accessible to a wider range of software designers.

Space Codesign Systems Inc. is an experienced team dedicated to making your project—our project—a success! By choosing our solution, you are also choosing valuable support.



To request a call, a demo or a quotation,
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