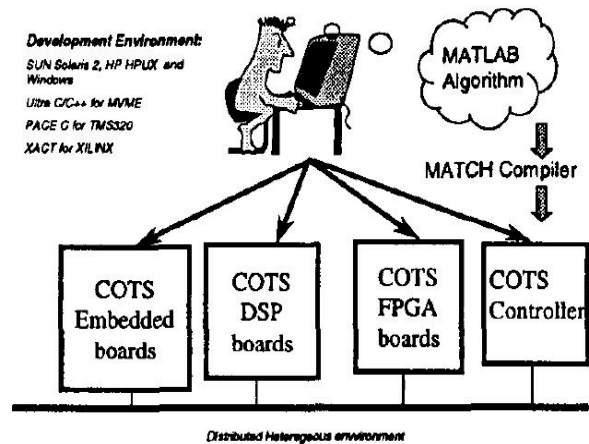# A MATLAB Compiler For Distributed, Heterogeneous, Reconfigurable, Computing Systems

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As reconfigurable computing headed into the 21st century, it was widely recognized that compilation technology would be a limiting issue in the advancement of the field. For the full power of reconfigurable computing to be utilized, compiler technologies that support computer languages used by large numbers of programmers and scientists were needed. Although the earlier development of C compilers for field-programmable systems had somewhat addressed this concern, a gap still existed in reconfigurable computing support for applications expressed in MATLAB, a widely popular language used for signal processing and scientific computing.

This paper provides a high-level view of a MATLAB compiler targeted at systems that include a diverse set of computing resources. The compiler first converted MATLAB code into an abstract syntax graph consisting of a collection of smaller subgraphs. Each subgraph can then be targeted to multiple FPGAs, a digital signal processor (DSP), or a Unix-based processor system. The FPGA implementations included a simple message passing protocol to simplify data exchange across devices. For complicated applications, the compilation environment allowed for the use of program directives to guide the compiler towards better mapping decisions. The authors demonstrated the effectiveness of their compiler system by using it to compile several applications to all three computing substrates. For all the included benchmarks, the FPGA implementation provided the most parallelism and the largest speedup.

The work described in this paper provided several steps forward in compilation technology for reconfigurable systems. First, it drew attention to the need for reconfigurable system compilers to not only target FPGAs, but also a heterogeneous system of compute components. Second, and more importantly, it provided a first step in the development of the MATLAB compilation tools in Xilinx System Generator that are used by thousands of engineers annually.

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