Evaluation of Graphical Programming and Automated Code Generation Software Tools for Use in Missile Defense Applications

Rick Pancoast rick.pancoast@lmco.com
Chris Robbins crobbins@mcci-arl-va.com
Rocco Dragone rocco.dragone@lmco.com
Joann Harvey joann.t.harvey@lmco.com
Walter Spehalski @ walter.r.spehalski@lmco.com

Lockheed Martin Corporation
Management Communications and Control, Inc. (MCCI)

Introduction

Lockheed Martin is committed to developing new technologies to support the Shipboard Ballistic Missile Defense (BMD) block upgrade program. Of particular interest to us are software tools that will reduce block transition cost and risk. Under the Missile Defense Agency SBIR program, Management Communications and Control, Inc. is evaluating their high performance development software tools, the Autocoding Toolset®, for use in the missile program. Lockheed Martin is supporting this SBIR effort through a comprehensive evaluation in our Advanced Digital Processing Laboratory. This paper presents goals and objectives for the evaluation and partial results anticipated by the time HPEC 2005 is held.

Autocoding Toolset® Overview

The Autocoding Toolset® includes tools for graphical application specification, design, automated import of MATLAB® scripts, rapid prototyping and automated code generation. The graphical specifications are translated to source code for industry "best practice" multi-tasking, multi-threaded implementations for production computers. The "virtual circuit" graphical specifications are translated to near error free application source code with technology similar to that of the electronic design SPICE tools. Productivity gains approach an order of magnitude. The computational performance of applications developed with the Autocoding Toolset® meets industry performance standards.

Evaluation Objectives

Lockheed Martin's objective is to evaluate the software tools for suitability for use in shipboard ballistic missile defense block upgrade program. This includes:

1. Assessment of the suitability of the Autocoding Toolset® for supporting development of large complex high performance applications typical of those anticipated for shipboard BMD use. Emphasis will be placed on determining whether codes generated from the tools data flow formats can meet performance requirements for computing performance and dynamic response to threat scenario driven reconfiguration requirements.

2. Productivity gains associated with tool use to include cost and schedule reduction, code error rates, and gains in efficient use of hardware through support of an iterative codesign approach to mapping application specifications onto hardware architectures.

3. Support for rapid prototyping. The capability of the tools to generate rapid prototypes of applications targeting laboratory resources other than final embedded targets will be evaluated. The productivity impacts of up front verification of applications requirements with prototypes automatically generated from requirements specifications will be assessed. The performance of these prototypes will be an issue as it is highly desirable to realize prototypes with performance sufficient to support verification on data sets large enough to ensure significance of numerical results within practical processing times. If prototype performance is sufficiently good, incorporating functional design in codesign iteration will be possible. Of particular interest is MCCI's emerging capability to seamlessly inject functionality specified in MATLAB® into parallel components of existing applications . The speed up of MATLAB® and the execution new function prototypes in the context of larger applications can reduce the cost and risk of block transitions. Additionally, we will be interested in support for verification of transitioning prototype code to finished production codes.

4. Ease of integration into larger application systems. Critically important data and control inter faces of high performance applications created MCCI's software tools to the larger shipboard BMD systems will be evaluated. Often integration of component codes into the larger systems is as demanding as developing component codes. Support for this important aspect of large application system development and life cycle maintenance will be evaluated.

Plans

In the near term, Lockheed Martin is working with a data flow graph implementation of the GMTI radar benchmark developed by Lincoln Labs for the DARPA PCA program[1]. This application has been well accepted as a high performance computing benchmark and is ideal for the familiarization and initial experimentation. We plan to use its realization as a prototype for a training vehicle to gain expertise with MCCI's tools. We will then investigate porting this application to various platforms evaluating performance, scalability and ease of integration. We anticipate presenting results of this early investigation at HPEC 2005. In the longer term, we intend to implement a

radar process representative of shipboard ballistic missile defense processing requirements to support a more comprehensive evaluation of the technology's support for meeting our objectives.

References

1. James Lebak, Jeremy Kepner, Henry Hoffmann, Edward Rutledge, Parallel VSIPL++: An Open Standard Software Library for High Performance Parallel Signal Processing, Proceedings of the IEEE, Vol. 93, No. 2, February 2005.