

PRODUCTS

Block Diagram

RIDE

ImPro Lab

VIDSP Studio

VIDSP Suite

OORVL Design Studio

Automatic C Code Generation From a Graphical Design

Overview

Hyperception's C Source Code Generator works in conjunction with Hypersignal Enterprise Edition graphical design environments to automatically produce source code in the high-level C language. First, a design worksheet is created graphically and is constructed to represent the engineer's algorithm. This visual design is then saved in a file that contains the information, which relates to the algorithm components and data flow, and the specific parameters of the design. This file is then used by the C Source Code Generator to create source files that represent the 1) initialization of the system, 2) the utility functions and algorithm source code, and 3) the main controlling executive for the system. A combination of a limited expert-based system, in conjunction with an automatic rule-based decision methodology allow for the creation of efficient, well-written source code.

This application note describes how a Hypersignal Block Diagram Enterprise Edition simulation design can be transformed into its ANSI C source code counterpart. The resulting C source code can be used in a variety of ways. For example, the portability of the C language permits the resulting source code to be transferred to alternative platforms such as UNIX-based systems and high-end workstations.

NOTE: *While this approach of generating C source code from a graphical design can be used to develop real-time DSP applications through traditional DSP C cross-compilation techniques, for an increasing variety of real-time applications the interested user should consider Hyperception's Hypersignal RIDE graphical design environment for real-time DSP development. RIDE does not require any C source code generation steps to implement DSP algorithms and instead allows for direct DSP object code generation to target specific DSP architectures. RIDE's graphical DSP compilation technique allows for more efficient algorithm implementation and real-time design flexibility. RIDE also provides for heterogeneous multiprocessor support, DSP code profiling, full-featured COFF support, target DSP memory map control, access to symbolic information, DSP application export, interrupt hooking and synchronization control, DSP memory operations, and much more.*

Product Specific Information

The ANSI C Source Code Generator is a useful option for the Hypersignal Block Diagram and RIDE Enterprise Edition graphical design environments. Augmenting the simulation and modeling capabilities provided by both Block Diagram and RIDE, this software development tool automatically creates C source code. The source code produced represents the algorithm depicted visually within the graphical design environment. Benefits of the C Source Code Generator are many: the man-time savings for a particular project can be significant, and maintainability of the generated source code will save considerable engineering resources over time thereby allowing the design engineer to spend more time improving aspects of the overall design. One important aspect of automatic C source code generation that is worth considering is the overall speed of development of a project or product, which translates into a decrease in time-to-market. In today's fast-paced area of high-tech engineering design, many companies have found that they can improve their time-to-market by utilizing automatic C source code generation techniques.

Description

Before source code can be automatically generated with the C Source Code Generator there must first be a Block Diagram design simulation of the algorithm. This is accomplished by creating a worksheet project with individual block components and arranging them to construct a specific algorithm or design. The data flow for the algorithm is represented by lines that have been established via mouse-click connection logic. An example design simulation is presented in the first part of the next section, and is used as the basis for source code generation for this application note.

Once a worksheet simulation has been completed within the Block Diagram environment then the C Source Code Generator is used to create the C source code for the design. The second part of the next section discusses this process and also presents some generated C source code for the design example.

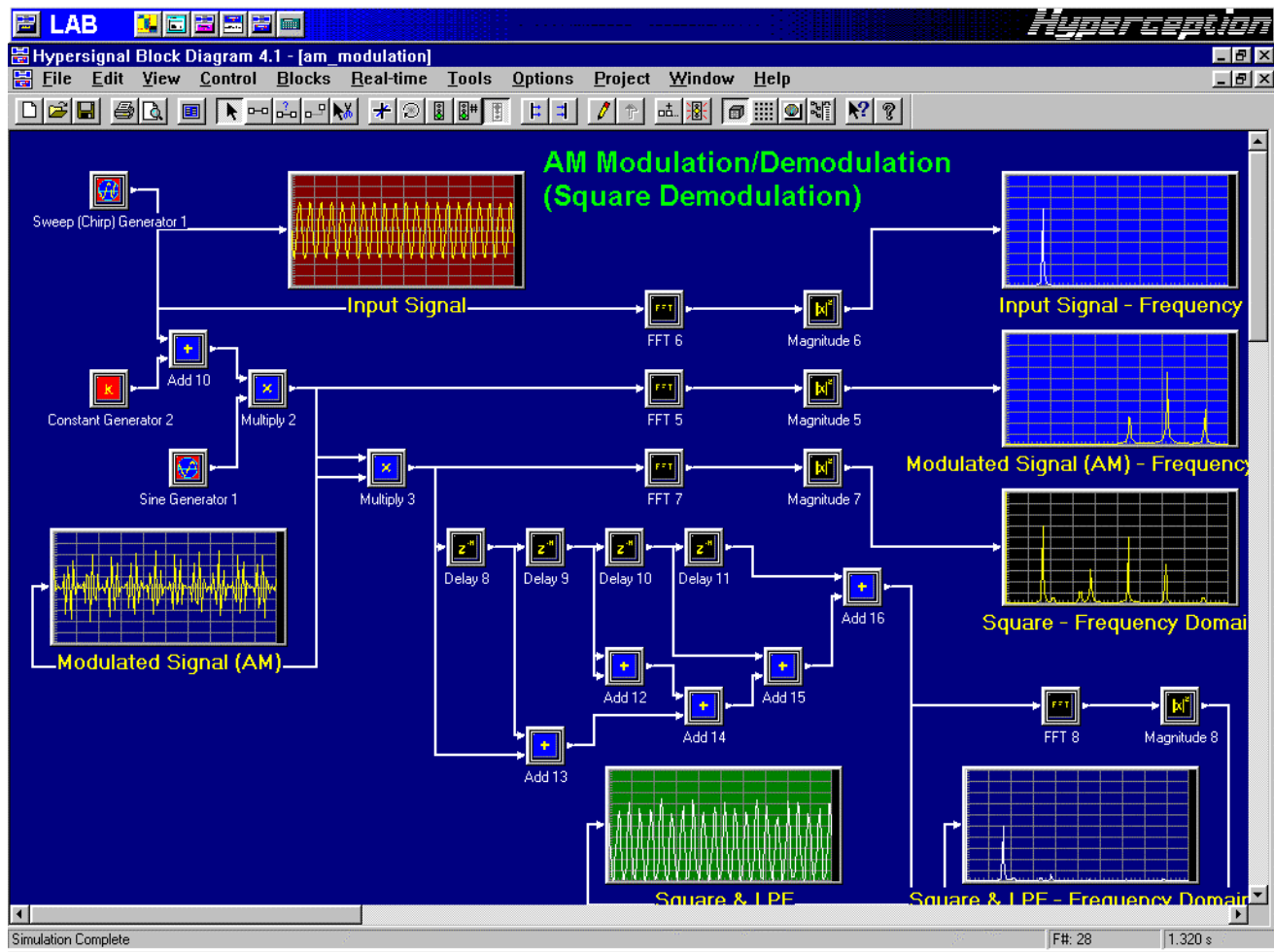


Figure 1. Hypersignal Block Diagram Design Simulation

Implementation

Design Simulation

The first step for this example involves creating a simulation within the Hypersignal Block Diagram graphical design environment. Block Diagram contains a large block component library from which the building blocks of the algorithm can be chosen.

By arranging and connecting block component icons, signal processing and algorithm implementation can be programmed, adjusted, and easily tested. The visually designed block diagram algorithm can then be used for simulation, proof-of-concept designs, and final software solutions.

In this example we are implementing an AM Modulation/Demodulation (Square Demodulation) algorithm. As can be seen in Figure 1, above, a Block Diagram worksheet design has been graphically constructed from block component icons. The example worksheet is comprised of several block component functions that have been arranged and connected to establish the proper data flow for the algorithm. The individual design parameters for each block component, such as sample rate, amplitude settings, and data precision, have been selected and the entire design simulated in Block Diagram.

Automatic C Source Code Generation

After all design parameters have been set accordingly in Block Diagram to produce the desired results, and the design worksheet has been saved, the next step is to generate source code for the design.

The Block Diagram design simulation is converted to source code form through use of the ANSI C Source Code Generator application. This tool allows you to very quickly produce source code, which would have otherwise taken a much longer time. Figure 2, below, shows a typical C Source Code Generator Project Workspace, and provides a list of files produced.

The C source code that is created is organized into several files. This includes the main body of the program, as well as an initialization section and a utility section. The main body of code is responsible for the calling of the appropriate design routines, which will implement the algorithm. The initialization section of code is responsible for setting all algorithm design parameters. The routines that actually perform the data computations are organized in the utility file. All of the files created by the C Source Code Generator can be user-modified. This allows you the option of modifying the design in the event you wish to make some changes.

The ANSI C source code at this point can be compiled directly into an executable program, complete with graphical display outputs. Any standard C compiler can be used to compile the source code. When executed the program will produce the identical results as were first obtained in the original Block Diagram design worksheet.

Because the source code created by the C Source Code Generator is written in ANSI C, the algorithm can be used on many types of platforms since C is a portable language.

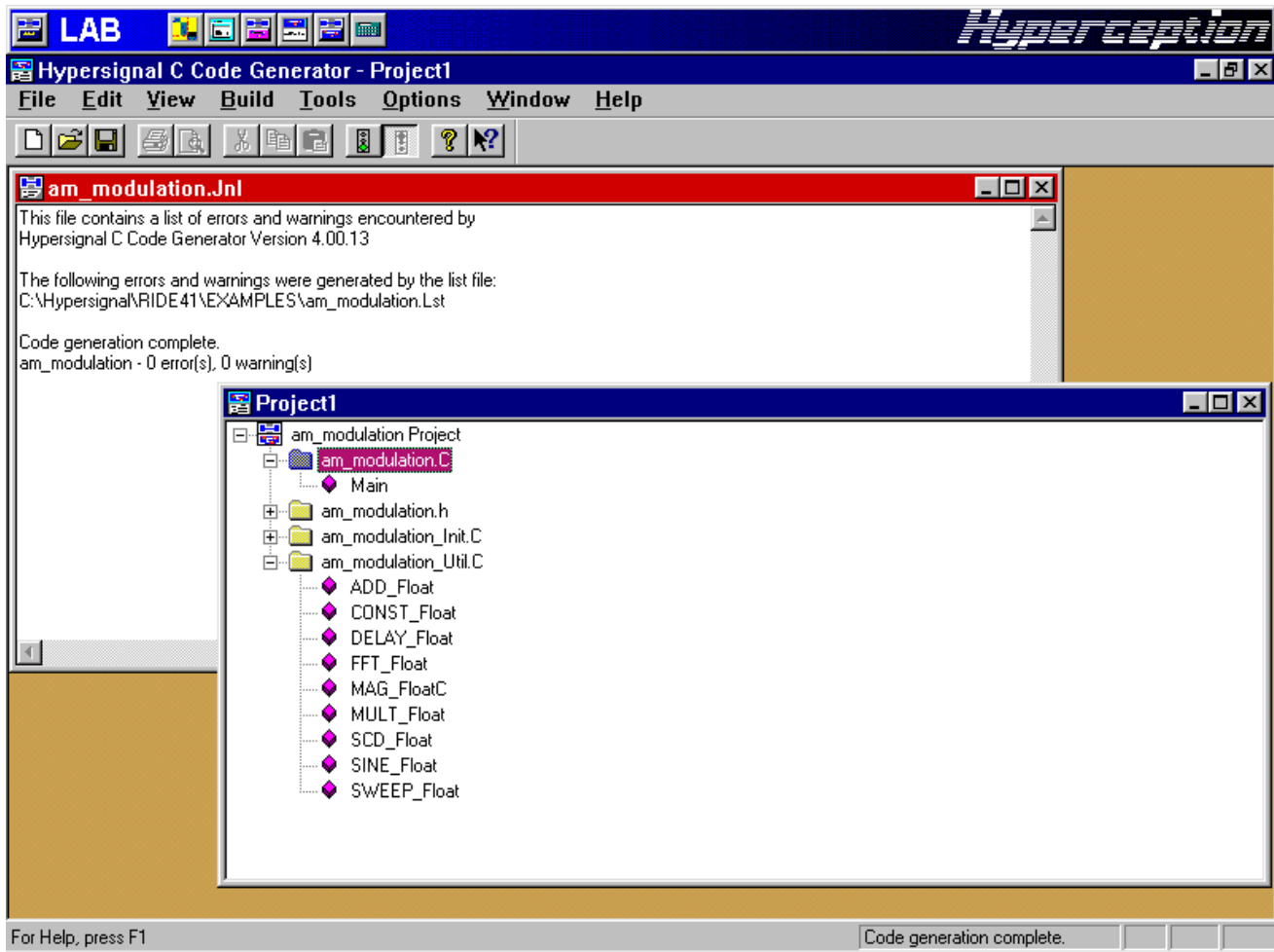


Figure 2 – ANSI C Source Code File Generation

Figure 3, below, shows some code sections from the generated C source files. The resulting C source code can be conveniently edited from within the C Source Code Generator application. The source files can be compiled using a standard C compiler.

Expandability

Both the Block Diagram product and the C Source Code Generator allow for the introduction of user-defined block components. The user can easily and simply create new custom block components unique to a particular design project by using an included Block Wizard utility. The C Source Code Generator provides for a “Learn” function that allows these newly created components to be utilized in simulations and subsequent C source code generation. This makes it easy for the user to adapt the product to a particular field of interest and lowers the technical risk for a given design project.

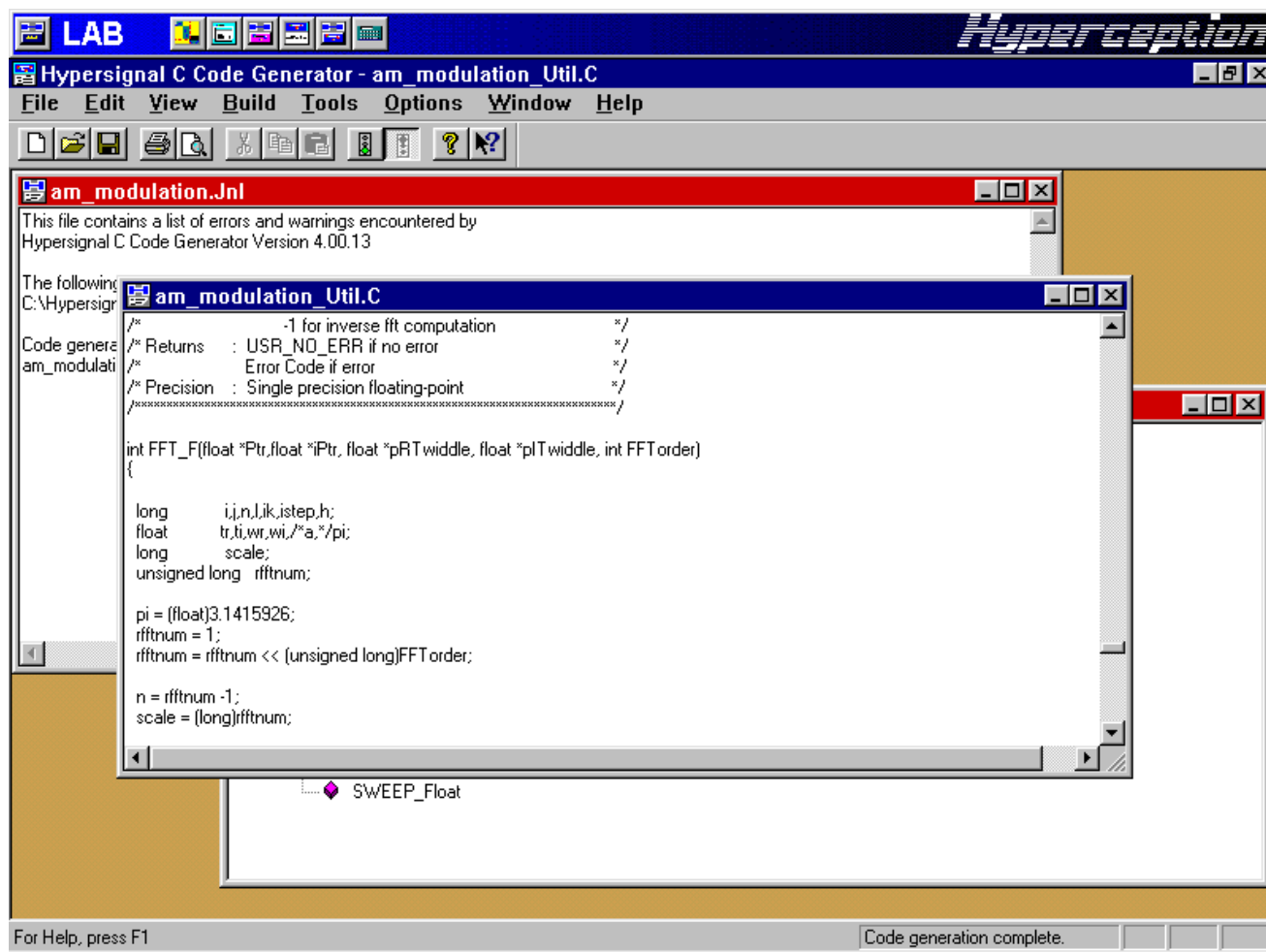


Figure 3. A Section of Generated Source Code

Applications

The entire design has been conducted in the Hypersignal Block Diagram graphical design environment without the need for writing and debugging time-consuming simulation code as is required by traditional methods. Use of the ANSI C Source Code Generator allowed the source code for the design to be produced automatically in a fraction of the time it would have taken if the design were to be written by hand. This reduction in development time can be advantageous for companies who are trying to streamline development cycles and improve their time-to-market.

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