Instructions for Compiling FAST using IVF for Windows®

Excerpt from a draft of the NWTC Programming Handbook

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The following instructions are provided to give users a general idea on how to compile the FAST code. These instructions have been developed using FAST 7.01.00a-bjj. Please note that names and number of source files may change in different releases; the Compile_FAST.bat script included in the FAST archive will contain the names of all the files required to compile the code.

Before compiling, make sure you have downloaded all of the source files you need to compile. For FAST 7.01.00a-bjj, this includes FAST[*], AeroDyn[†] v13.00.01a-bjj, and NWTC Subroutine Library[‡] v1.04.01.

Using the Command Line

FAST is currently distributed with a batch file called "Compile_FAST.bat" that will compile the code using IVF. We are aware that a makefile would be a better alternative, but do not currently have the resources to create and support it.

Before using Compile_FAST.bat, you must modify variables in the sections labeled "set compiler internal variables" and "local paths."

Set Compiler Variables

In the "Set Compiler Internal Variables" section, you make sure that the proper paths and environment variables are set for the compiler and linker. The number one reason that people have trouble with the Compile_FAST.bat script is that this step has not been done correctly. The **blue** text shown in Figure 1 (copied from Compile_FAST.bat) must be changed to reflect your compiler.

```
REM ------------------------------------------------------------------------
REM                   set compiler internal variables
REM ------------------------------------------------------------------------
REM    You can run this bat file from the IVF compiler's command prompt (and not
REM    do anything in this section). If you choose not to run from the IVF command
REM    prompt, you must call the compiler's script to set internal variables.
REM    TIP: Right click on the IVF Compiler's Command Prompt shortcut, click
REM    properties, and copy the target (without cmd.exe and/or its switches) here:

CALL "C:\Program Files (x86)\Intel\ComposerXE-2011\bin\ipsxe-comp-vars.bat" ia32 vs2008
```

Figure 1: The "Set Compiler Internal Variables" section of Compile_FAST.bat for FAST v7.01.00a-bjj. Text in blue must be changed by the user before running the script.

[*] http://wind.nrel.gov/designcodes/simulators/fast/
[†] http://wind.nrel.gov/designcodes/simulators/aerodyn/
[‡] http://wind.nrel.gov/designcodes/miscellaneous/nwtc_subs/

One way to find this command is to open the shortcut to the IVF command prompt (also called IVF Build Environment in some versions). You can usually find the shortcut at a location named something like **Start > All Programs > Intel** *CompilerName* **>** *CommandPromptName*. (Different versions of the compiler may have more submenus.) Right click on the shortcut and click "Properties." (See Figure 2 for an example.) A window similar to Figure 3 will open.

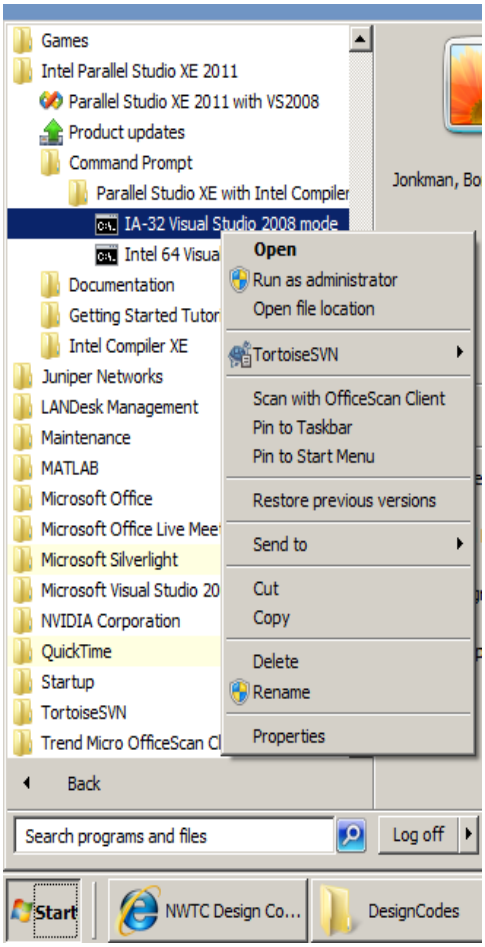

Figure 2: An example of finding the IVF command prompt shortcut

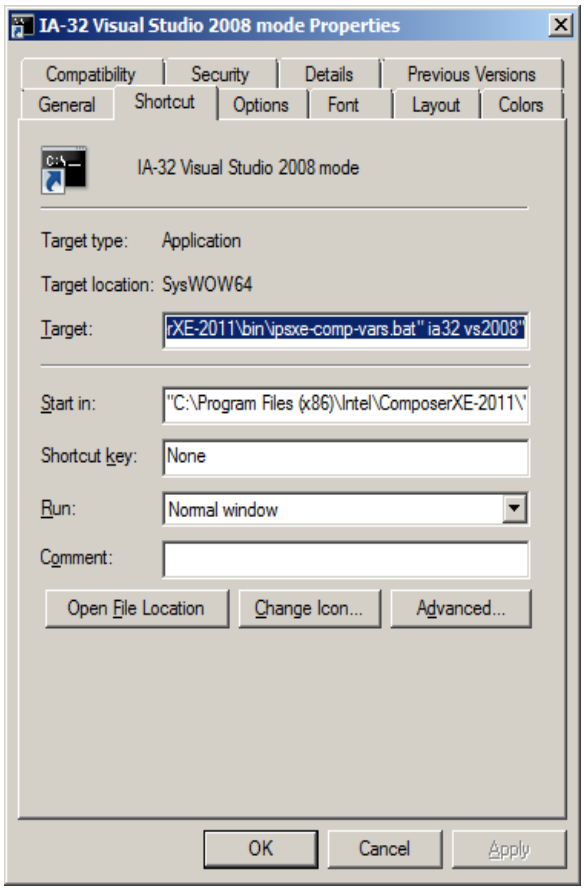

Figure 3: The properties window for an IVF command prompt shortcut

Copy the text from the Shortcut's "Target" field and paste it in the Compile_FAST.bat script:

```
C:\Windows\SysWOW64\cmd.exe /E:ON /V:ON /K ""C:\Program Files
(x86)\Intel\ComposerXE-2011\bin\ipsxe-comp-vars.bat" ia32 vs2008"
```

You will need to remove the call to cmd.exe and its switches, leaving you with the name of a batch file (and possibly some of its arguments):

```
"C:\Program Files (x86)\Intel\ComposerXE-2011\bin\ipsxe-comp-vars.bat" ia32 vs2008
```

If you do not want to call this batch file from Compile_FAST.bat, you may remove the line from the file. However, you must then run Compile_FAST.bat *only* from the compiler's command line

window. Please refer to your compiler's documentation about using ifort and calling it from the command line.

Set Local Paths

The second section that must be modified in Compile_FAST.bat is labeled "Local Paths." This section needs to be updated with the paths to the source files you are trying to compile. The text that must be updated is shown in **blue** in Figure 4.

```
REM ------------------------------------------------------------------------
REM ------------------------ LOCAL PATHS -----------------------------------
REM ------------------------------------------------------------------------
REM -- USERS WILL NEED TO EDIT THESE PATHS TO POINT TO FOLDERS ON THEIR LOCAL --
REM -- MACHINES.  NOTE: do not use quotation marks around the path names!!!! ---
REM ------------------------------------------------------------------------
REM NWTC_Lib_Loc is the location of the NWTC subroutine library files
REM AeroDyn_Loc  is the location of the AeroDyn source files
REM Wind_Loc     is the location of the AeroDyn wind inflow source files
REM FAST_LOC     is the location of the FAST source files
REM ------------------------------------------------------------------------

SET NWTC_Lib_Loc=C:\Users\bjonkman\Data\DesignCodes\NWTC Library\source
SET AeroDyn_Loc=C:\Users\bjonkman\Data\DesignCodes\AeroDyn\Source
SET Wind_Loc=C:\Users\bjonkman\Data\DesignCodes\AeroDyn\Source\InflowWind\Source
SET FAST_Loc=C:\Users\bjonkman\Data\DesignCodes\FAST\Source
```

Figure 4: The "Local Paths" section of Compile_FAST.bat for FAST v7.01.00a-bjj. Text in blue must be changed by the user before running the script.

Run The Script

After you have modified Compile_FAST.bat, you can run it from the command line by typing

```
Compile_FAST.bat
```

in the directory where the batch file is stored. Figure 5 shows the screen output after a successful build using Intel® Composer XE 2011. Notice the title of the command window after Compile_FAST.bat has been run. The script that you call in the "Set Compiler Internal Variables" section to set the paths and environment variables for the IVF compiler also modifies the title of the window. If the title does not say anything about the compiler, please verify that you have modified Compile_FAST.bat correctly.

Creating FAST with the User-Defined Control Options for Interfacing with GH Bladed-style DLLs

If you would like to compile FAST with the user-defined control options that include the interface to GH Bladed-style DLLs, you can use this script to do so. After modifying Compile_FAST.bat as outlined above, you must also copy the FAST source files named UserSubs.f90 and UserVSCont_KP and rename them UserSubs_forBladedDLL.f90 and UserVSCont_KP_forBladedDLL.f90 respectively. In UserSubs_forBladedDLL.f90, you must comment out subroutines UserHSSBr and UserYawCont, and in UserVSCont_KP_forBladedDLL.f90, you must comment out subroutine UserVSCont. To compile, you type

```
Compile_FAST.bat dll
```

at the command line. The executable file that is created will end with `_DLL.exe`.

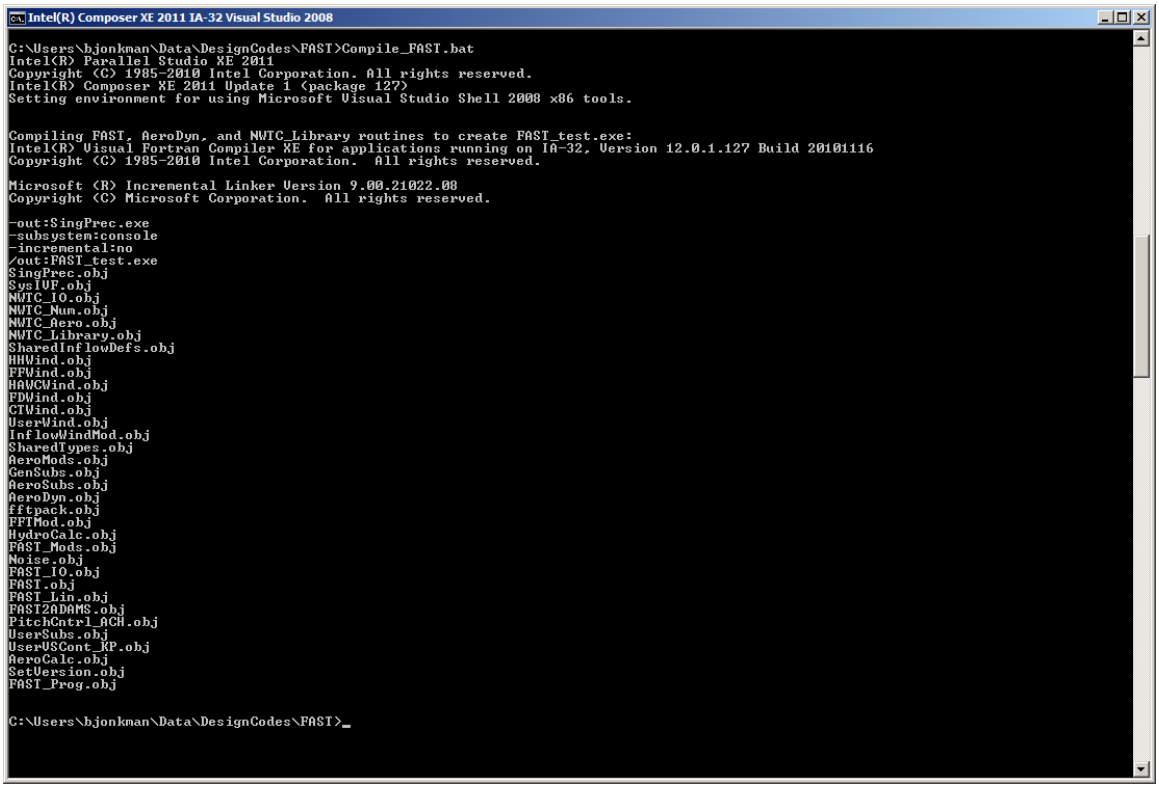

Figure 5: The command prompt window after Compile_FAST.bat has been run.

Using Microsoft Visual Studio

Microsoft® Visual Studio is an integrated development environment (IDE) that provides useful features for editing source code, compiling, and debugging. The following instructions for compiling FAST have been developed using Microsoft Visual Studio 2008; the steps will be similar for other versions. Note that the size and location of some of the windows in Visual Studio may also vary based on your configuration settings.

Open a New Project

Open Visual Studio and create a new project of type **Intel® Visual Fortran > Console Application**. Choose the **Empty Project** template, and select a name and location for the project before clicking **OK**. See Figure 6.

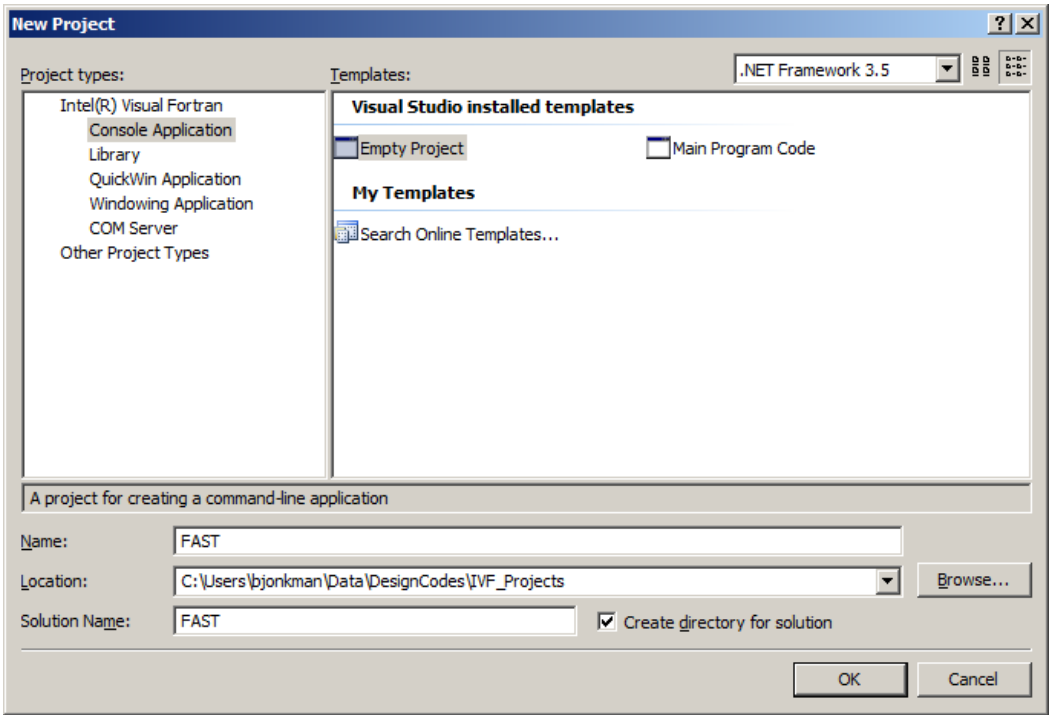

Figure 6: The New Project window in Visual Studio

Add Source Files

Next, you will need to add the source files for FAST and the other codes (components or modules) it uses. To keep the source files organized, you can create folders for each of the components. In the Solution Explorer window, right click on the **Source Files** folder under **<project name>**. Choose **Add > New Folder**, and a new folder named "NewFolder1" will be added under the **Source Files** folder. (See Figure 7.) Rename the folder something descriptive, such as "FAST" for the FAST source files.

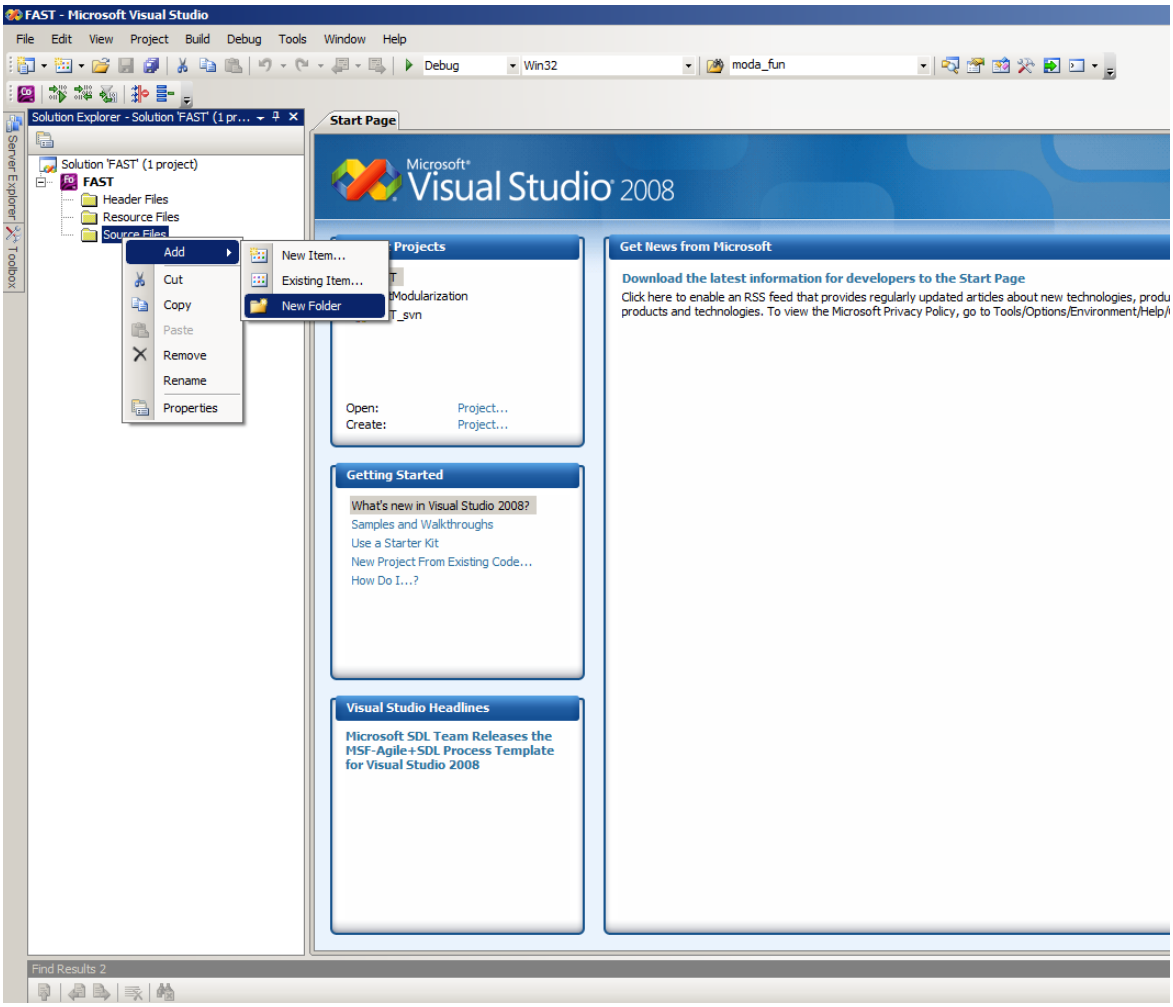

Figure 7: Adding new folders for source files in Microsoft Visual Studio 2008. Note that the Soultion Explorer **window may be located in another part of the screen**

Then right-click on the folder you have just added and choose **Add > Existing Item…** (Figure 8).

In the **Add Existing Item** window that opens, you must browse to the folder containing the source files for that component (FAST in this case). Select all of the source files that you need from the directory.

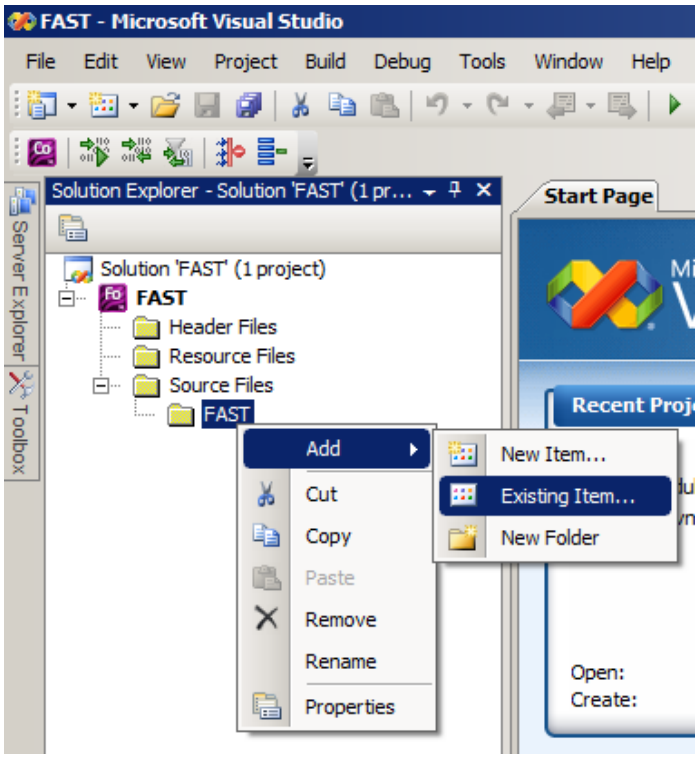

Figure 8: Adding existing source files to a Visual Studio 2008 project.

Create new folders under **Source Files** for each of the other components and add their source files to your project. When you are finished, your **Solution Explorer** window will look something like Figure 9. (Note that if you choose to use the user-defined control options for interfacing with a GH Bladed-style DLL in FAST v7.01.00a-bjj, your list of FAST source files will include BladedDLLInterface.f90, UserSubs_forBladedDLL.f90, and UserVSCont_KP_forBladedDLL.f90. It will *not* include PitchCntrl_ACH.f90, UserSubs.f90, or UserVSCont_KP.f90. The file UserSubs_forBladedDLL.f90 is a copy of UserSubs.f90 with subroutines UserHSSBr and UserYawCont commented out. The file UserVSCont_KP_forBladedDLL.f90 is a copy of UserVSCont_KP with subroutine UserVSCont commented out.)

Set Compiler Options

Next, you must set the compiling options for the project. On the main menu, select **Project > <project name> Properties**. (Note: if you select an individual source file and then click on **Project > Properties**, you will change the properties for *only* that source file. Make sure you are changing properties for the *entire* project here.)

A **<project name> Property Pages** window will open. See Figure 10. In the **Configuration** dropdown box at the top of the window, select "All Configurations" to set the compiler options for all configurations.

Select **Configuration Properties > Fortran > Data** in the box on the left. In the window on the right, select **Use Bytes as RECL = Unit for Unformatted Files** and choose **Yes (/assume:byterecl)**. (This option is required for InflowWind's coherent structures). Because FAST v7.01.00a-bjj still has some unresolved issues relating to local variables and their initialization, you will also need to set **Local Variable Storage** to **All Variables SAVE /Qsave**, and set **Initialize Local Saved Scalars to Zero** to **Yes (/Qzero)**. (Note that once we find and fix these issues, we will no longer compile with /Qsave and /Qzero.) Click **OK** to save your changes and close the window. The window in Figure 10 shows the project properties with the compiling options changed as necessary.

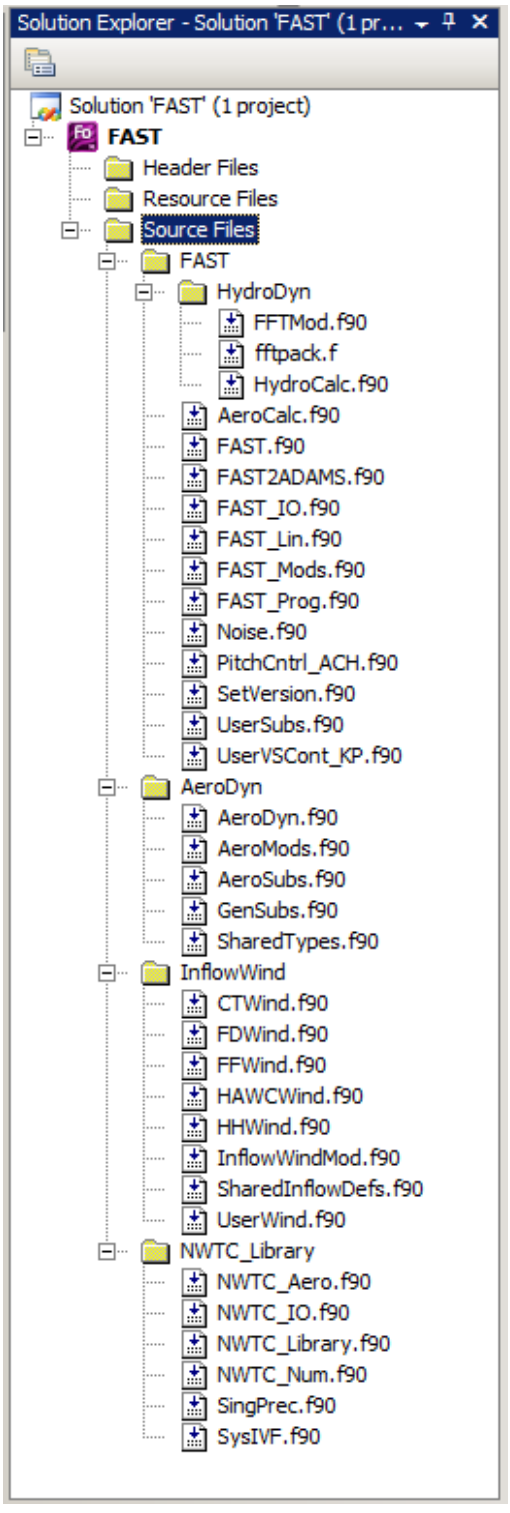

Figure 9: The source files for FAST v7.01.00a-bjj listed in the Visual Studio Solution Explorer **window**

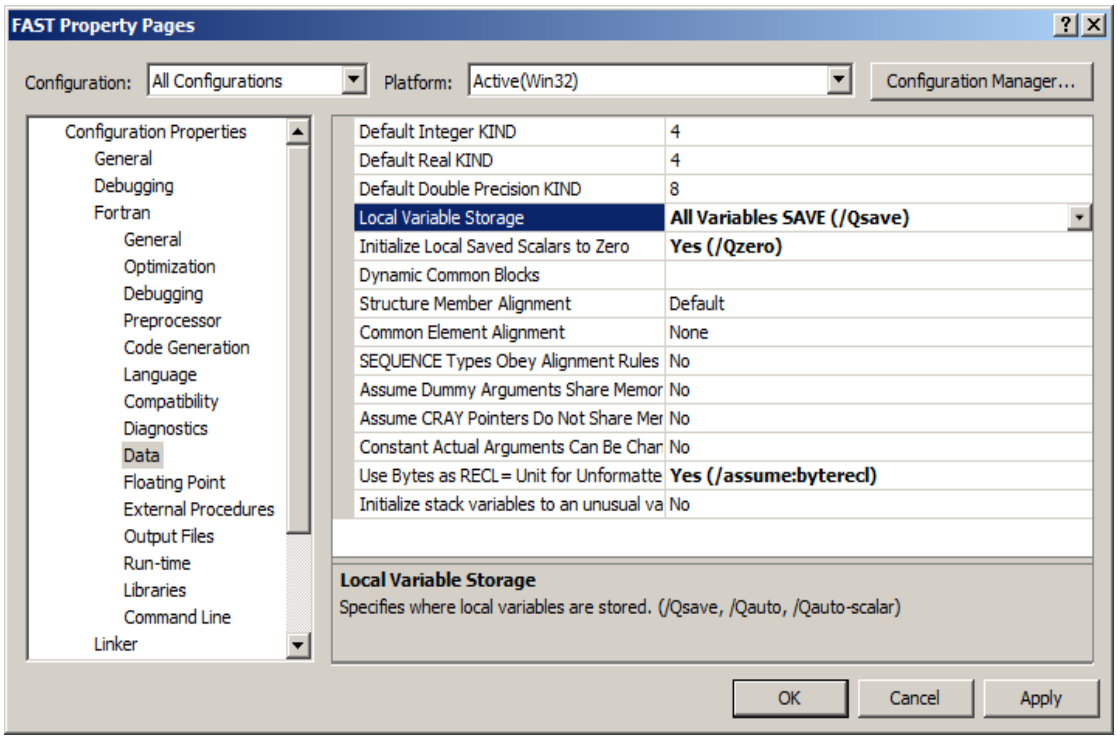

Figure 10: The <project name> Property Pages **window in Visual Studio with the compiling options changed for FAST v7.01.00a-bjj**

Build the Project

To build your project (create an executable file), you can choose from "Debug" or "Release" mode (or create your own settings). Debug mode is set to disable optimizations and generate debugging information. It will compile faster and run slower than Release mode. Release mode is set to optimize the code for speed. It does not generate debugging information. You can choose the desired configuration mode by clicking on the dropdown box on the toolbar or choose **Build > Configuration Manager** from the main menu.

After you have picked the appropriate configuration, choose **Build > Build Solution** from the main menu. The **Output** window will show your progress. (See Figure 11.) Any errors encountered during the build process will also appear there.

This step creates an executable file, named by default <project location>\<configuration name>\<project name>.exe. If you want to change this file's name, you can do so in the **<project name> Property Pages** window. (Select **Project > <project name> Properties** from the main menu.) The name of the executable is defined under **Configuration Properties > Linker > General > Output File**. See Figure 12.

Note that *$(OutDir)* in Figure 12 refers to the **Output Directory** defined under **Configuration Properties > General** in the same window. (Remember that any changes you make apply to only the configuration that is selected at the top of this window.)

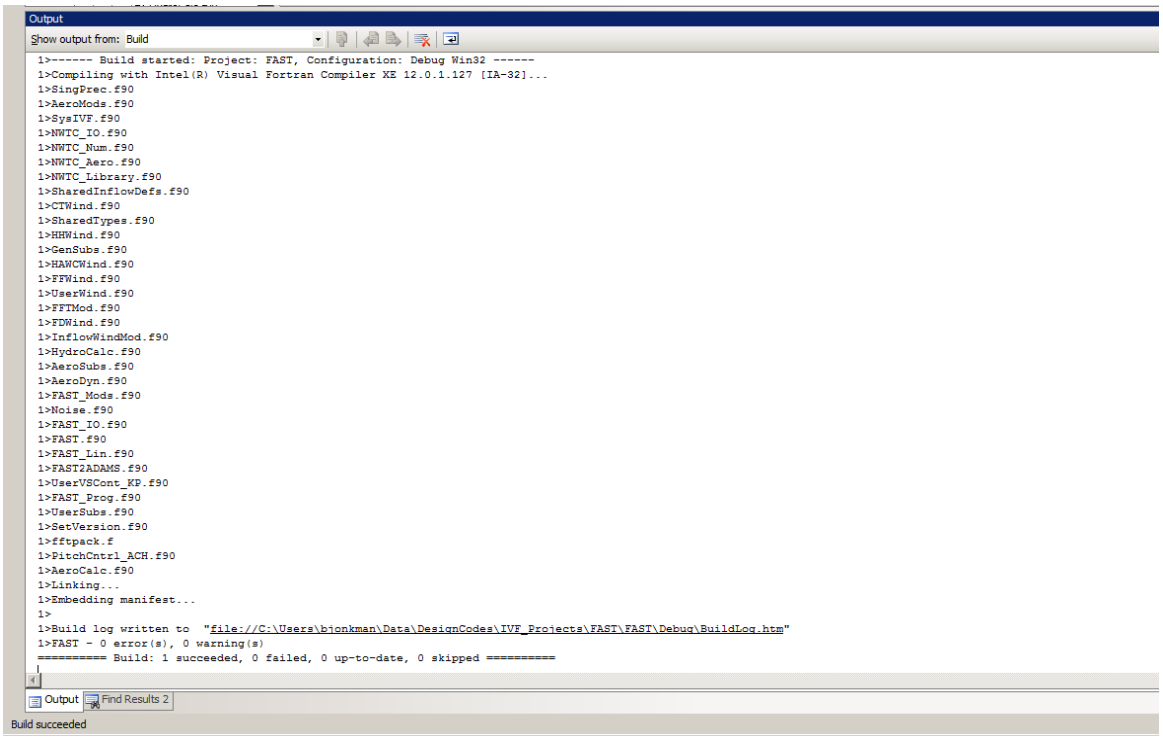

Figure 11: The Output **window in Visual Studio after building FAST using the Debug configuration.**

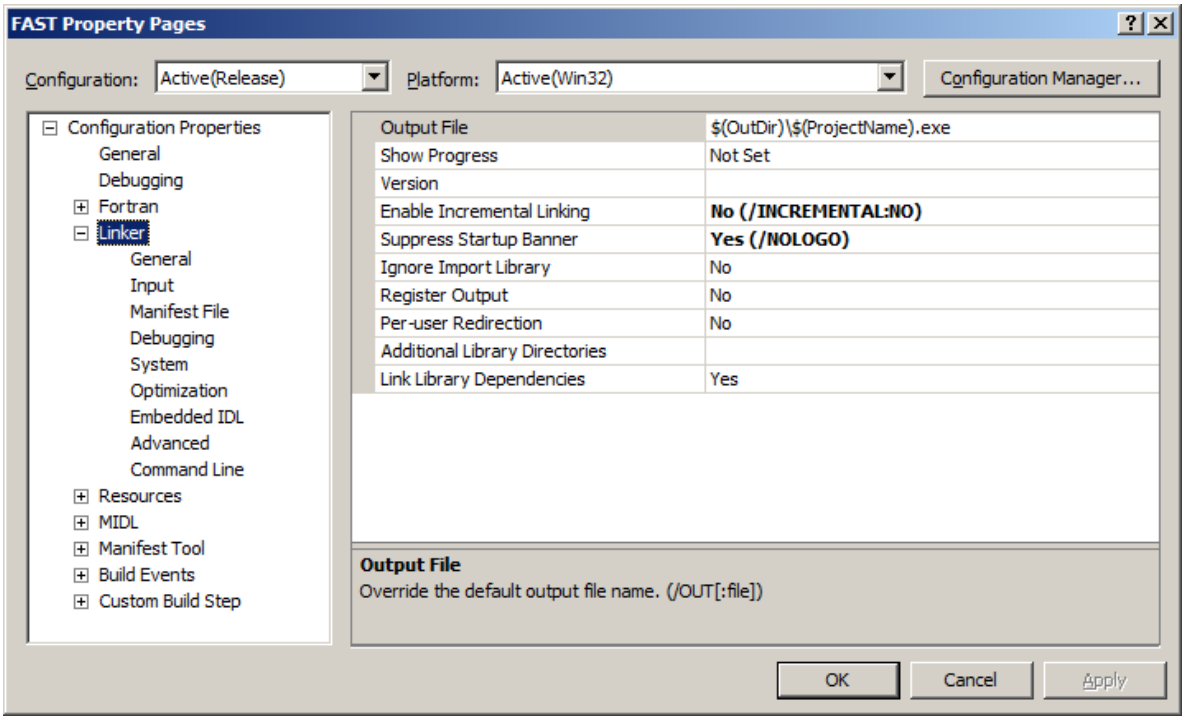

Figure 12: The <project name> Property Pages **window in Visual Studio, showing the location of the Output File.**