

Using FAST for LabVIEW

Paul Fleming and Bonnie Jonkman (11 February 2013)
National Renewable Energy Laboratory

This brief document is meant to explain how to use the FAST DLL for LabVIEW

Introduction

The FAST for LabVIEW version of FAST is intended to provide a version of FAST which can be coupled to LabVIEW and used within a real time environment. Early versions of this FAST version were developed ad-hoc and have been employed continuously within the PXI controllers of the two CART test turbines at the NWTC.

With this new version, the LabVIEW option becomes a standard method with settable flags within the primary FAST input file (.fst) for selecting LabVIEW controls inputs.

Overview

The essential implementation of the FAST for LabVIEW controller involves these steps:

- FAST is compiled as a DLL (instead of an executable).
- The DLL then has 3 interface functions that LabVIEW can access:
 - FAST_RT_DLL_INIT (Perform initializations [read inputs, etc.]
 - FAST_RT_DLL_SIM (Perform one time-step of simulation)
 - FAST_RT_DLL_END (Clear allocatable arrays and close files)
- In the LabVIEW code, the program must:
 - Call FAST_RT_DLL_INIT early on in the program (the FAST input file name is an argument to this subroutine)
 - Iterate from then on:
 - Compute actuator inputs to FAST
 - Call FAST_RT_DLL_SIM with these inputs
 - Collect the measured outputs
 - The controller time-step and simulation time-step are constrained to equal each other to ensure that the value for DT specified in the FAST input file matches the LabVIEW loop time step

We recommend switching off all FAST output file options in the FAST and Aerodyn input files.

- Check example VIs for demos of calling the FAST library

Last Details

- DLL goes in the project directory on the HOST computer
- Input files go in the nirt/system directory on the PXI
- All output written to the screen in a normal FAST simulation is instead written to a file called "CONSOLE.TXT". (This is hard-coded in the OpenCon() subroutine in SysIVF_Labview.f90.)
- *LabVIEW 2012 SP1* and *LabVIEW Real-Time 2012 SP1* are required (the DLL will not load in previous version of LabVIEW).

Compiling

The FAST DLL for LabVIEW is compiled with Intel® Visual Fortran (IVF) 10.1.024 using Visual Studio 2003. Newer compilers are not yet supported.

When compiling, avoid adding any debugging or traceback information to the DLL because these features require Windows® libraries that are not available in the LabVIEW environment. The DLL must also be single-threaded to avoid memory leaks when used in the LabVIEW environment.

- Use the normal source files for compiling the FAST executable, except:
 - Replace FAST_Prog.f90 with *FAST_RT_DLL.f90* (found in the LabVIEW\source folder in the FAST archive of FAST v7.02.00d-bjj), and
 - Use *SysIVF_Labview.f90* instead of other Sys*.f90 files from the NWTC Library (requires NWTC Library v1.06.00a or later).
- Compiling options:
 - Options required for FAST 7.02.00d-bjj: */Qsave /Qzero /assume:byterecl /real_size:32*
 - Optimization options for release-mode: */O2 /inline:speed*
 - Options to create a static, single-threaded dll: */dll /libs:static /nothreads*
- Linking options: */DELAYLOAD:"imagehlp.dll" /DLL delayimp.lib*

The Windows® batch file *Compile_FASTforLabview.bat* can be used to compile the DLL. This script is very similar to the script for compiling the executable version of FAST from the command line, as described here: <https://wind.nrel.gov/forum/wind/viewtopic.php?f=4&t=642>.