Large Model Simulation in Simulink® Models Using Legacy Code Tool

>Aircraft engine generic simulation example

>Pros, cons, and issues

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imagination at work

Requirements Summary

1. Automatically create a Simulink block representing legacy code
2. Inputs of the block consist of
    - ID flag
    - Inputs including data bus
    - Dynamic adjustments to internal code
    - Outputs of the block consist of all parameters in one bus to be used for debugging scopes as well as real interfaces

2. Automatically create a separate Simulink block representing block adjustments.

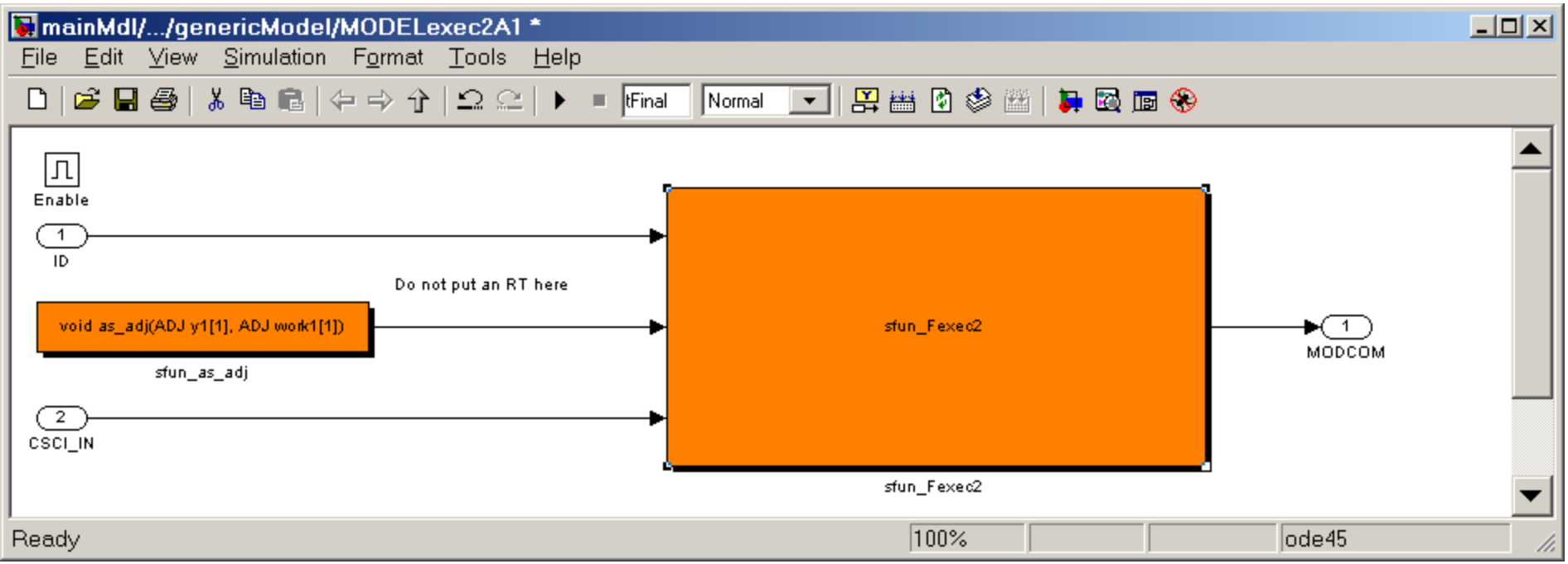
3. Automatically create a separate Matlab bus definition file defining
    - global common structure
    - adjustment structure
    - Inputs structure

4. Provide for incremental compilation.

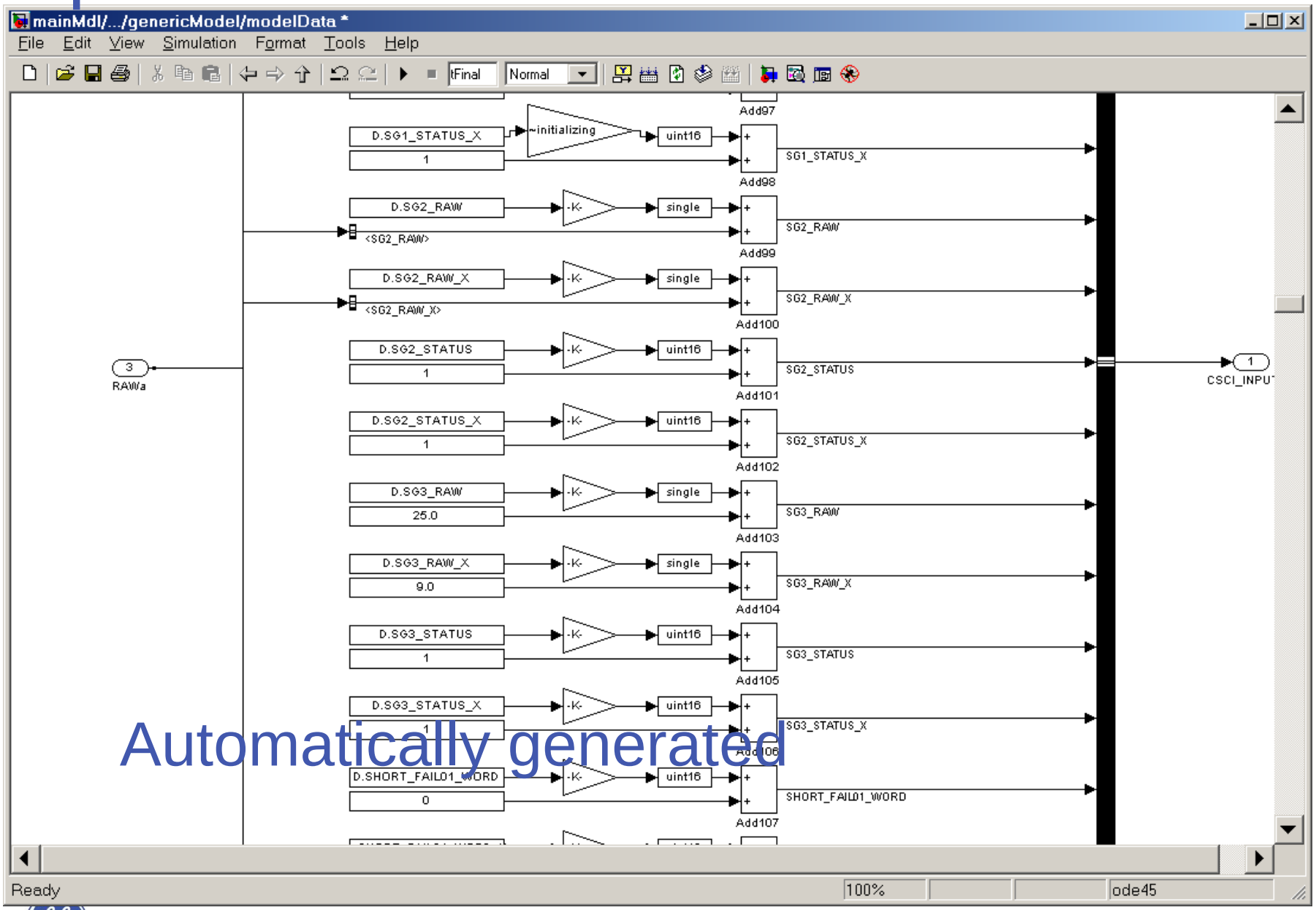
5. Provide for block adjustment changes in a separate user-edited file. Initially for any given build, this file is blank and default values are used automatically and built-in to the block code.

6. Work with standard installation of Microsoft Visual C++ compiler (.NET)

Model In Use in Simulation

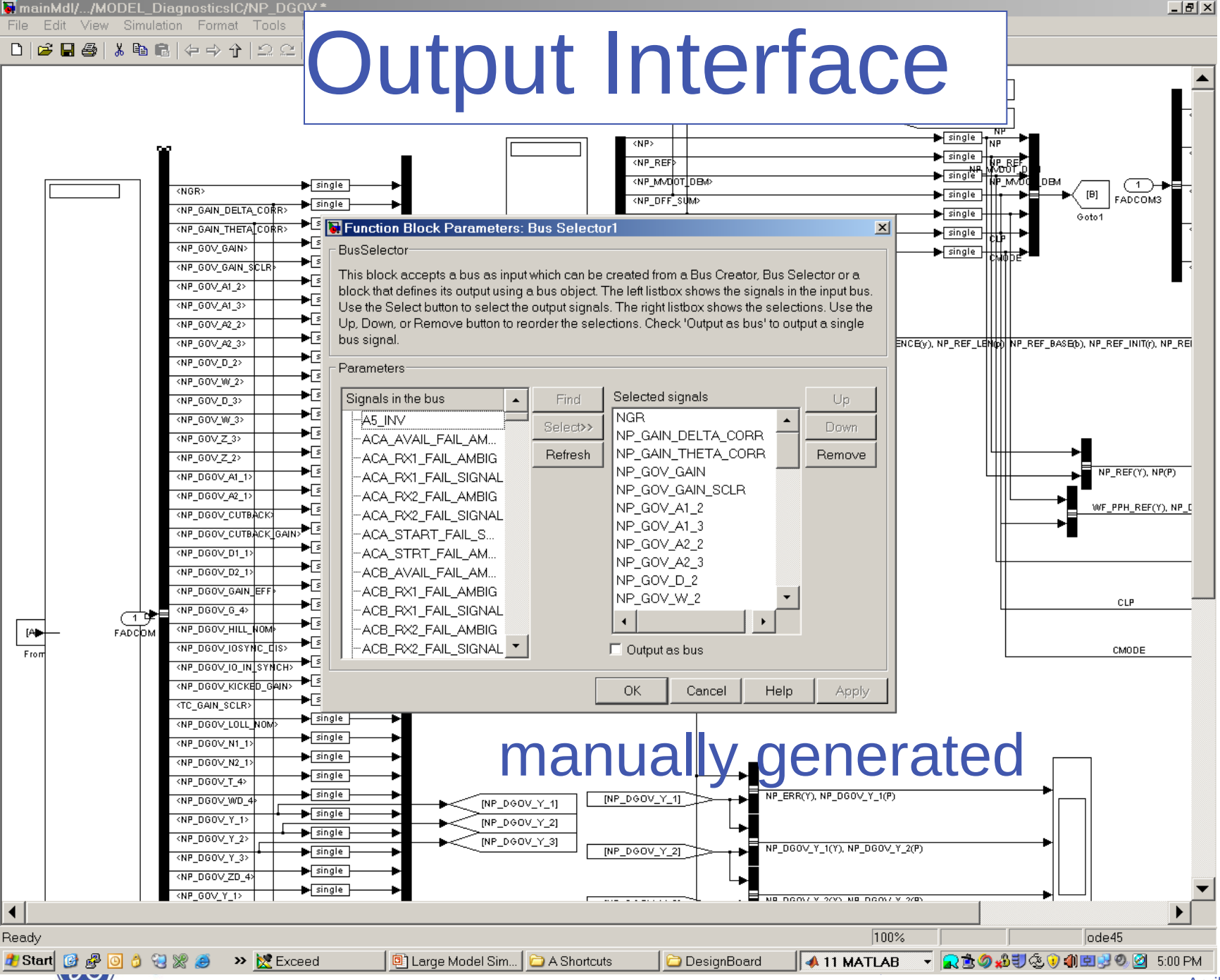


Input Interface

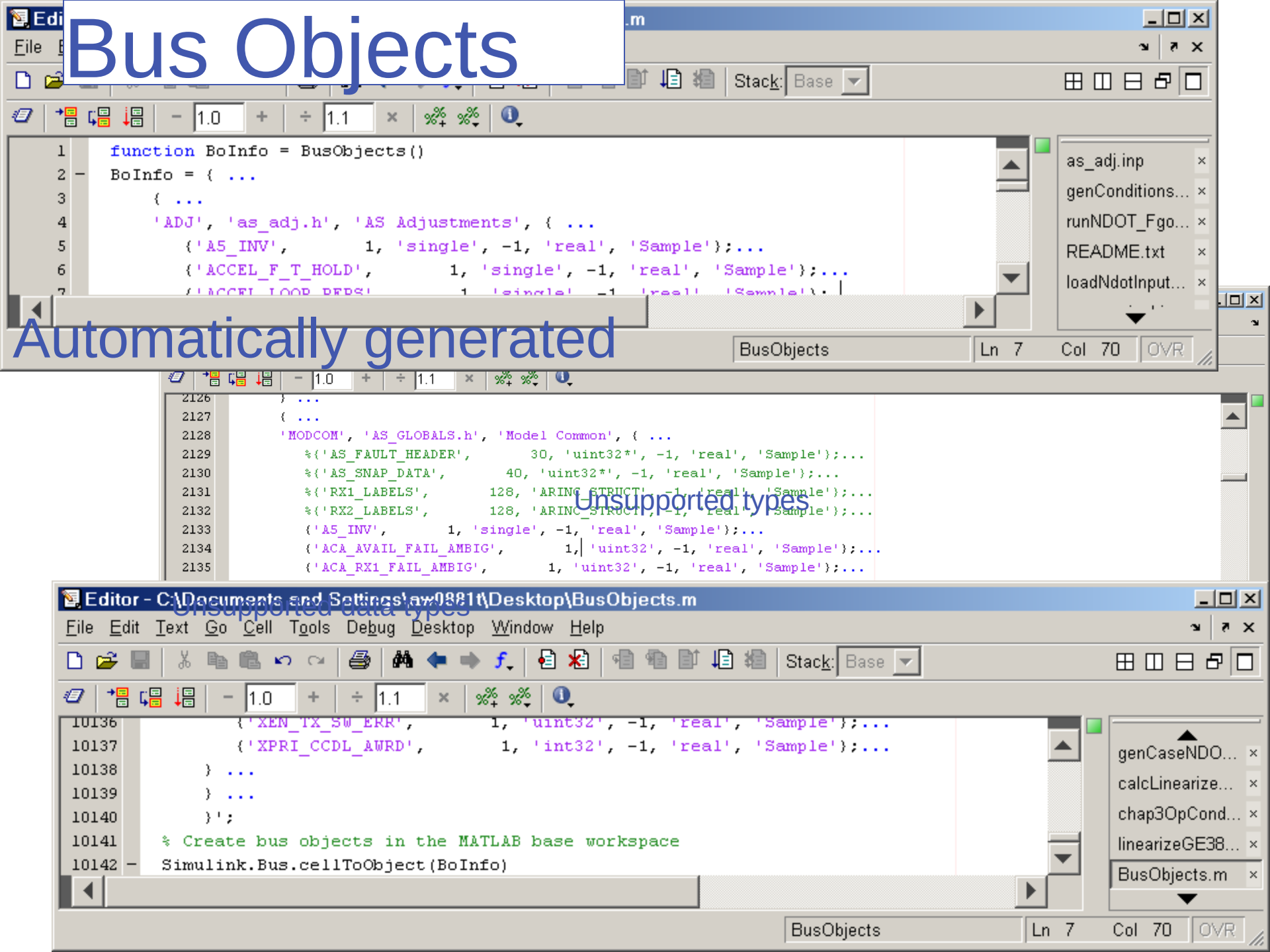


Automatically generated

Output Interface



Bus Objects

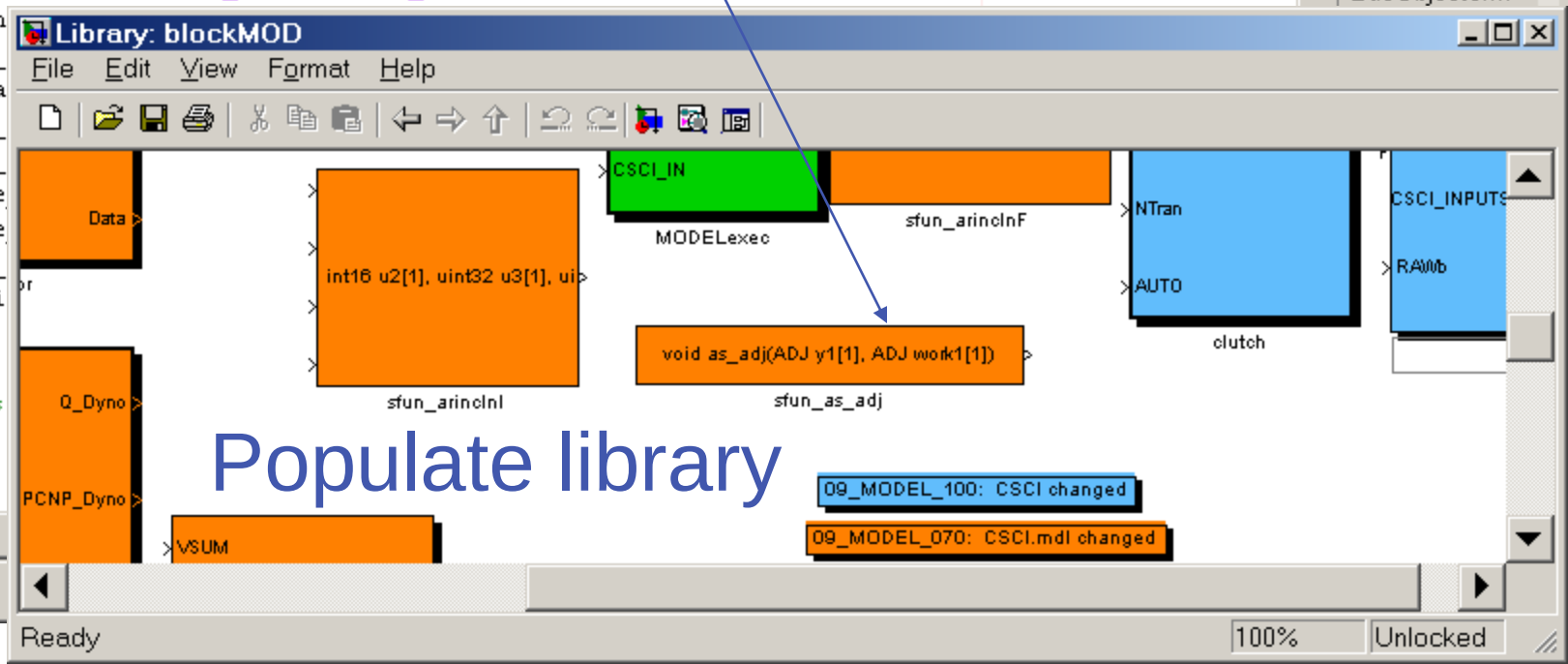

Automatically generated
Unsupported types
Unsupported data types
function BoInfo = BusObjects()
BoInfo = { ...
'ADJ', 'as_adj.h', 'AS Adjustments', { ...
{'A5_INV', 1, 'single', -1, 'real', 'Sample'};...
{'ACCEL_F_T_HOLD', 1, 'single', -1, 'real', 'Sample'};...
'MODCOM', 'AS_GLOBALS.h', 'Model Common', { ...
%{'AS_FAULT_HEADER', 30, 'uint32*', -1, 'real', 'Sample'};...
%{'AS_SNAP_DATA', 40, 'uint32*', -1, 'real', 'Sample'};...
%{'RX1_LABELS', 128, 'ARINC_STRUCT', -1, 'real', 'Sample'};...
%{'RX2_LABELS', 128, 'ARINC_STRUCT', -1, 'real', 'Sample'};...
{'A5_INV', 1, 'single', -1, 'real', 'Sample'};...
{'ACA_AVAIL_FAIL_AMBIG', 1, 'uint32', -1, 'real', 'Sample'};...
{'ACA_RX1_FAIL_AMBIG', 1, 'uint32', -1, 'real', 'Sample'};...
{'XEN_TX_SW_ERR', 1, 'uint32', -1, 'real', 'Sample'};...
{'XPRI_CCDL_AWRD', 1, 'int32', -1, 'real', 'Sample'};...
} ...
} ...
} ...
}';
% Create bus objects in the MATLAB base workspace
Simulink.Bus.cellToObject(BoInfo)
Editor - C:\Documents and Settings\aw0881t\Desktop\BusObjects.m
File Edit Text Go Cell Tools Debug Desktop Window Help
Stack: Base
as_adj.inp
genConditions...
runNDOT_Fgo...
README.txt
loadNdotInput...
genCaseNDO...
calcLinearize...
chap3OpCond...
linearizeGE38...
BusObjects.m
BusObjects
Ln 7 Col 70
OVR

Legacy Code Call

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
if ~exist('sfun_as_adj.mexw32', 'file') || ~exist('as_adj_m.mdl', 'file')...
        || getStamp('as_adj.c')      > getStamp('sfun_as_adj.mexw32') ...
        || getStamp('src/as_adj.h') > getStamp('sfun_as_adj.mexw32')...
        || makeAsAdj,
    as_adj = legacy_code('initialize');
    as_adj.SourceFiles = {'as_adj.c'};
    as_adj.SampleTime = [0.192 0];
    as_adj.IncPaths = {'src', '.'};
    as_adj.SFunctionName = 'sfun_as_adj';
    as_adj.OutputFcnSpec = 'void as_adj(ADJ y1[1], ADJ work1[1])';
    legacy_code('compile', as_adj);
    if ~exist('block.mdl', 'file') || reCreateSl_as_adj || makeAsAdj,
        fprintf('\nslblock_generate as_adj...');
        open
        set_
        lega
        set_
        set_
        save
        save
        set_
        fpri
    end
end
%%%%%%%%%%%%
```

Incremental Compilation feature

Populate library



Incremental Compilation Features

- Minimize design cycle time (logic drawing → simulation)
- Use file time-stamps
- Save build history in .mat files.
- Saves parameter definitions in .mat files to detect additions
- CVS configuration management preserves time-stamps
- Writes and manages Bus Objects file
- Writes and manages the automatically generated interface files

Pitfalls

- IPC synchronization between DOS processes and Matlab simulations can result in commons mismatch and SEG faults, or worse, bad results without compiler warnings.
- Barebones legacy code tool does not manage states – use trimmers to initialize
- Incomplete data type support
- Debug compilation will not produce symbolic info
- RT block interactions with bus not understood (solve with update specifications to legacy tool)