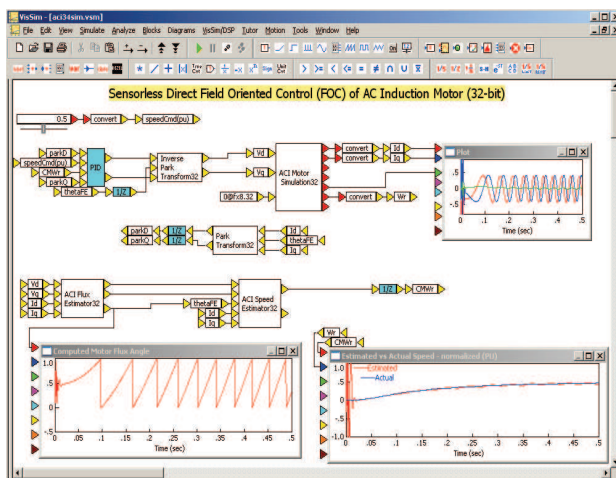


Model-Based Embedded Control Design

VisSim/Embedded Controls Developer is software for the rapid prototyping and creation of embedded controllers for the Texas Instruments DSPs, DSCs and MSP430 microcontrollers. VisSim/Embedded Controls Developer simulates and generates scaled, fixed-point ANSI C code, as well as code for on-chip peripherals. It supports TI LF280x, F2835x, F281x, F240x, C5416, C6713, and MSP430.

The Rapid Prototyping Process

Using VisSim/Embedded Controls Developer, you can build a model of your entire system, including the control algorithm and the plant. The controller subsystem can be built in scaled, fixed-point, and the plant in full-precision, floating point. You simulate the model in VisSim to verify, debug, and tune your algorithm, and to view the results interactively in graphical plots. Once the model is verified, you can generate production code for the controller and download the code to the target, all within the VisSim environment.



Target-Specific Blocks

VisSim/Embedded Controls Developer provides target-specific blocks that generate production code for on-chip devices. These blocks include analog ADC, ePWM, eCAP (event capture), SPI, SCI (RS232 serial), I2C, digital GPIO, QEP (quadrature encoder), CAN 2.0.

CAN Bus Support

CAN bus transmit and receive blocks support up to 32 CAN mailboxes on the TI C2000 series. Baud rates to 2 megabits are supported. Mailboxes are configurable from 0- to 8-byte data packet size. User-configurable addressing can be 11 or 23 bits. Remote frame requests and auto-answer are also supported.

Serial LCD

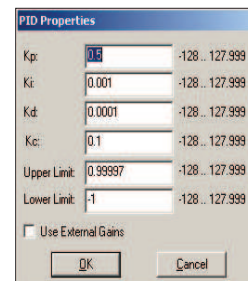
Serial LCD blocks support up to 4-line-by-20-column serial interfaced LCDs. You can compose text prompts, numeric formatting, field placement, and page address for each block. Additionally, runtime paging commands are supported. Serial baud rate, serial protocol, and LCD vendor format are user-configurable.

Scaled, Fixed-Point Algorithms

The VisSim/Fixed-Point block set performs simulation and efficient code generation of scaled, fixed-point operations. Overflow and precision loss effects are easily seen and corrected at simulation time. Auto-scaling speeds fixed-point development, while in-line code generation creates fast target code.

Highlights

- Performs rapid prototyping and generates code for embedded system development for TI DSP and MSP430
- Generates production C code with automatic scaling of fixed-point operations
- Simulates the effects of scaled, fixed-point truncation and precision loss
- Logs minimum and maximum values observed during simulation
- Compiles, links, and downloads the algorithm to the target
- Performs automatic programming of on-chip peripherals for TI F243, LF240x, F280x, F281x, C6713, C5416, and MSP430
- Validates algorithm using off-line simulation
- Uses JTAG hotlink for downloading and real-time communication for plotting responses and interactively changing parameters during target execution
- Retains the VisSim GUI while the algorithm executes on the target
- Supports serial port based LCD display



Dialog box for the Fixed-Point PID Regulator block. Parameter values are automatically scaled to fixed point for simulation and code generation.

TI C2000 Digital Motor Control Block Set

The TI C2000 Digital Motor Control block set is used for simulation and production code generation for motion control systems based on AC induction, brushless DC, PMSM, and stepper motors. It includes PID, 3-Phase PWM Drivers, Space Vector Waveform Generators, Park and Clarke Transforms, Volts-to-Hertz Profiles, sensorless flux and rotor speed estimation, and quadrature-encoder-based speed calculator. Example diagrams are included for sensed and sensorless vector control of PMSM and AC induction motors.

DSP-in-the-Loop Simulation

After simulation, the controller can be run on the target DSP, and take inputs from VisSim and write outputs to VisSim. VisSim/Embedded Controls Developer generates production quality fixed-point code, compiles, and links it. You can then replace the simulated controller with a DSP interface block, which automatically configures with the controller .OUT file and performs a JTAG download to the target DSP.

In DSP-in-the-loop simulation, the plant model runs on the host computer in VisSim while the control algorithm runs in real time on the target DSP. Real-time communication between the target DSP and VisSim is performed via the JTAG hotlink. The VisSim GUI is retained while you change controller gains and plot controller responses from the DSP.

Efficient Code Generation

VisSim/Embedded Controls Developer generates production level code. DSP target support includes a report to display the COFF section sizes of the generated execution file. For example, code generated for closed-loop motor control — including, PI controller, digital output, PWM, and encoder peripherals — runs at 300KHz on a 150MHz F28335 DSC.

Memory footprint is:

Code size	2095 bytes
Initialized data	501 bytes
Uninitialized data	504 bytes

```

fixed_point_elevator_control.c - Notepad
File Edit Search Help
;
static SIM_STATE tSim={0, 0.0005, 2.5,0,0.0005,delayIC177,SHBufIC177,0,0,0,0,
  outArgInfo177, inArgInfo177,2,1,0,1, 1, 0,0, cgMainBeriv,0,0,0,importBuf,0,1};
SIM_STATE *sIn=&tSim;

void cgMainBeriv()
{
  int t189;
  long t212;
  int t192;
  int t205;
  int t205;
  /* digetrl.bmp */
  dt = pulseTrain(0,0.05);
  t189 = ( IUNIT_DELAY( 0, dt ));
  GR_local = t12;
  t212 = (int)((sim->inSig[0]->u.Double * 1.67772e+007);
  if ( dt ) ISAMPLE_HOLD(0) = t212;
  xhat = imap1( 0, 1,MUL_SHIFT16( abs(MUL_SHIFT16( GR_local ,(short)(( ISAMPLE_HOLD(0)
  >>>16),9)),-16384,14));
  t192 = (- xhat +(short)((int)(( sim->inSig[1]->u.Double * 1.67772e+007)<<18));
  t205 = MUL_SHIFT16(DIU_SHIFT(MUL_SHIFT16(( t192 )--070:( t192 )>070x2000:0xffff000),
  imap1( 1, 1, abs( t192 ) ),10),31704,16,15),2816,15);
  controller_voltage = t189 ;
  sim->outSig[0].u.scaledInt.val = controller_voltage ;

  ILATCH_UNIT_DELAY( 0, dt , t205 );
}

main()
{
  simInit( &tSim );
  simInMap( 0 );
  simInMap( 1 );
}
  
```

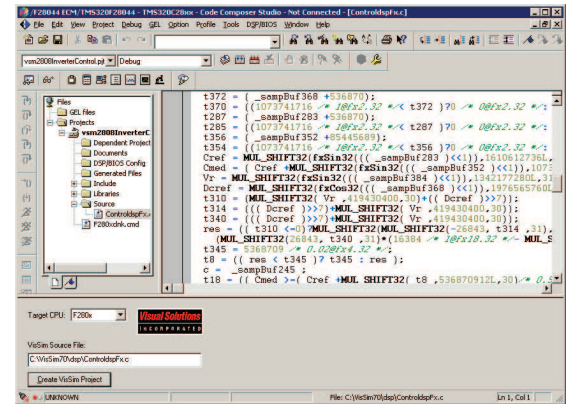
Example of automatic fixed-point code generation.

Automatic comments and full variable names consistent with those used in block diagram make code very readable and portable.

Fixed-point operations implemented as in-line macros and shift operations resulting in fast execution speed and small footprint.

VisSim/Code Composer Studio Plug-In

The VisSim/Code Composer Studio plug-in creates a CCS project that includes the generated code targeted for the TI DSPs, allowing the code to be integrated with other user-developed code. The project includes the generated .C file, as well as the necessary VisSim support libraries.



Automatically generated project from VisSim/Code Composer Studio plug-in.

What Comes with VisSim/Embedded Controls Developer

- Professional VisSim
- VisSim/Fixed-Point blocks and design tools¹
- TI C2000 Digital Motor Control block set²
- Peripheral blocks that generate code for on-chip devices
- VisSim/Code Composer Studio plug-in for automatic project creation

1. C2000, C5000, MSP430 only. 2. C2000 only.

