

# Video and Image Processing Blockset 2

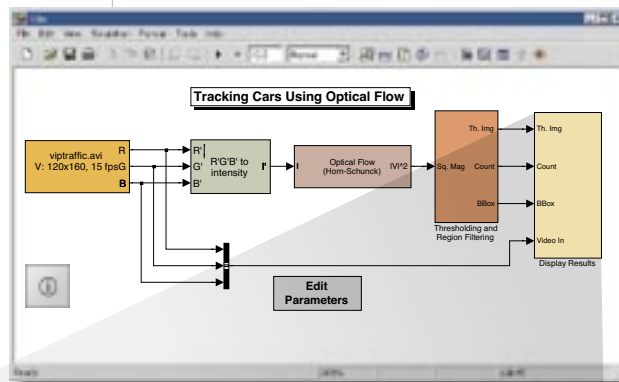
## Design and simulate video and image processing systems

The Video and Image Processing Blockset extends Simulink® with a rich, customizable framework for the rapid design, simulation, implementation, and verification of video and image processing algorithms and systems. It includes basic primitives and advanced algorithms for designing embedded imaging systems in a wide range of applications in aerospace and defense, automotive, communications, consumer electronics, education, and medical electronics industries.

Built-in block libraries provide two-dimensional (2-D) filters, conversions, geometric transformations, morphological operations, 2-D transforms, motion estimation techniques, and input/output (I/O) capabilities. The blockset supports floating- and fixed-point data types for modeling, simulation, and C-code generation. It provides analysis and statistical functions to enable rapid optimization and debugging of your models. These functions include video displays, scopes, and other techniques for visualizing image and video data and validating simulation results.

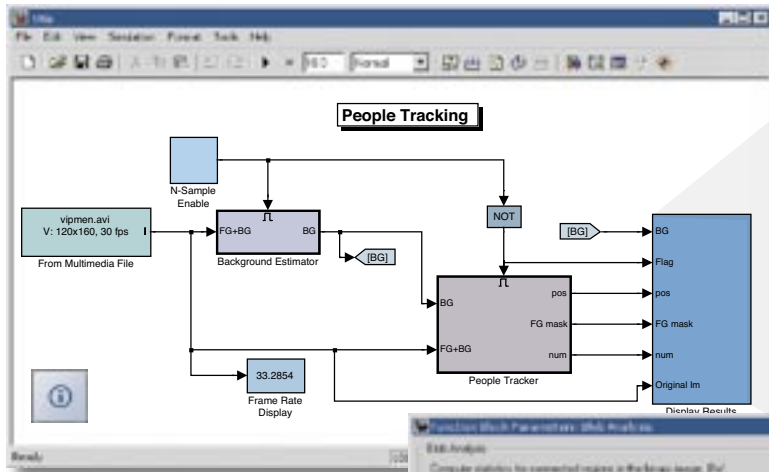
### KEY FEATURES

- Models and simulates real-time video and imaging systems in floating-point, integer, and fixed-point data types of arbitrary word length
- Integrates with Real-Time Workshop® to automatically generate embeddable ANSI/ISO C code
- Imports multimedia file I/O and displays the status of video streams during simulation and post-simulation
- Creates and deploys 2-D filters, transforms, and geometric transformation primitives
- Provides standard color video and image conversion techniques, including color space conversion and chroma resampling
- Includes video and image analysis and enhancement algorithms, such as edge detection, thresholding, morphology, statistics, compositing, optical flow, and deinterlacing



Tracking cars model uses an optical flow estimation technique to estimate the motion vectors in each frame of the video sequence. The counter in the upper left corner of the Results window tracks the number of cars in the region of interest.





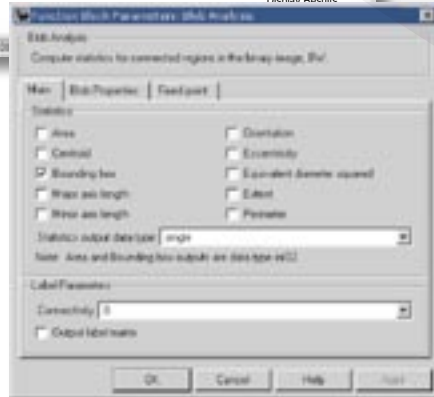
A people-tracking application uses Blob Analysis block and Kalman filtering subsystem to detect and track each person in the video frame. Further processing ensures that the same people are tracked from one frame to the next, and a bounding box highlights each individual.

## Modeling and Simulating Video and Imaging Systems

The Video and Image Processing Blockset extends Simulink with a specialized library for designing the behavior of your imaging system. The Simulink environment provides tools for hierarchical modeling, data management, and subsystem customization that make it easy to create concise, accurate representations, regardless of your system's complexity.

All blocks in the Video and Image Processing Blockset support double-precision and single-precision floating-point data types. Most also support integer and fixed-point data types. (Fixed-point support requires Simulink® Fixed Point, available separately.)

Simulink and the Video and Image Processing Blockset enable you to run fast simulations for real-time embedded video, vision, and imaging systems. You can create executable specifications for communicating the system to downstream design teams and to provide a golden reference for verification throughout the design process.



## Generating and Optimizing C Code

The Video and Image Processing Blockset interfaces with Real-Time Workshop® and Real-Time Workshop® Embedded Coder (both available separately), enabling you to automatically generate ANSI/ISO C code from your models. You can deploy the generated C code from your models on programmable processors (DSP or GPP) or use it for large-scale simulations.

## Multimedia I/O, Video Viewer, and Display Blocks

The Video and Image Processing Blockset can import multimedia files, such as AVI, MPEG, WMA, or any file type supported by Windows Media (Windows platform only). Video viewer and display blocks enable you to view the status of the video stream in real

time throughout the model. You can start, stop, pause, and step through simulations one frame at a time. These time-saving features enable rapid design and debugging of your video and imaging system models.

The Video and Image Processing Blockset lets you:

- Send live video data to a video output device, monitor, or camera connected to the system
- View the video signal on your PC or workstation screen
- Write the input to an array in the MATLAB® workspace
- Display RGB or intensity video streams or images
- Write video frames to a multimedia file to analyze and share results
- Use the MPlay GUI to easily view video signals in Simulink models and to view video from files or the MATLAB workspace

The blockset enables you to insert text and graphic objects into the video stream, overlay and mark regions, or annotate and combine images.

## Filtering, Transforms, and Geometric Primitives

The Video and Image Processing Blockset provides primitives for 2-D filters, transforms, and geometric transformations.

You can use the 2-D filters to perform tasks such as sharpening, smoothing, and noise removal. The 2-D transforms let you analyze the frequency content of a video stream. For example, MPEG uses the DCT to compress the video pixel information by discarding unnecessary frequency content.

The Video and Image Processing Blockset lets you:

- Implement 2-D FIR filtering of input matrix,  $I$ , using a filter coefficient matrix,  $H$
- Output the complex fast Fourier transform in two dimensions (2-D FFT) of a real or complex input
- Rotate, resize, apply projective transformation, or translate images for alignment or image registration

The geometric transformation blocks provide three interpolation methods: nearest neighbor, bilinear, and bicubic, and enable a trade-off between precision and performance.

## Color Operations

Color operations, such as color space conversion, enable you to represent and manipulate color signals and convert between different video formats. For example, you can decouple color information from luminance and process these components separately.

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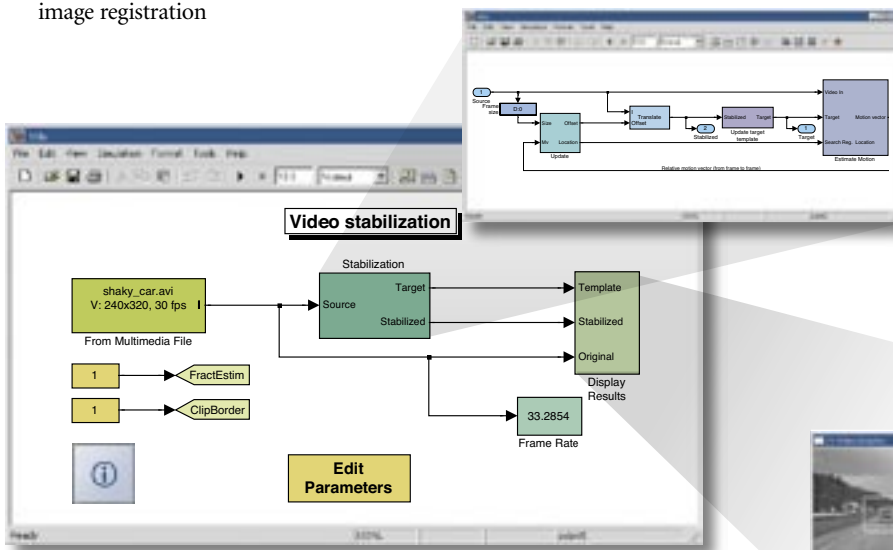
- Convert widely used color formats, such as RGB to/from YCbCr (Rec. 601 or 709), RGB to/from HSV, RGB to/from XYZ, RGB to/from  $L^*a^*b^*$
- Apply or remove gamma correction from an image
- Automatically or manually change an intensity image to a binary image (binarization)
- Downsample or upsample chrominance components of images

## Video and Image Analysis

Image analysis techniques enable you to extract information from video streams. For example, you can remove noise, correct for nonuniform illumination, or extract image features.

The Video and Image Processing Blockset lets you:

- Detect motion in a video sequence using techniques such as optical flow (Horn & Schunck and Lucas & Kanade), block matching for motion estimation, or 2-D sum of absolute differences (SAD)
- Match patterns to an existing template using techniques such as cross-correlation
- Judge the relative focus of a video scene
- Track and classify moving objects
- Separate foreground from background using segmentation techniques
- Identify object boundaries in an image frame using Canny, Sobel, Prewitt, or Roberts edge detection methods
- Use Blob Analysis to calculate statistics and return values that represent spatial coordinate locations, such as centroid or bounding boxes, for labeled regions in a binary image



Model illustrating a motion stabilization technique based on the SAD method. The stabilization subsystem (above) applies the SAD technique to remove unwanted translational camera motions and generate a stabilized video.



The Statistics library enables you to compute 2-D statistical analyses, such as variance, correlation, max, min, mean, standard deviation, and histograms. Mean variance and standard deviation can be computed on an arbitrary Region of Interest (ROI).

### Required Products

MATLAB®

Simulink®

Image Processing Toolbox

Signal Processing Blockset

Signal Processing Toolbox

### Related Products

**Embedded Target for TI C6000™ DSPs.**

Deploy embedded code onto TI C6000 and DM64x processor families

**Image Acquisition Toolbox.** Acquire images and video from industry-standard hardware

**Real-Time Workshop®.** Generate optimized, portable, and customizable code from Simulink models

**Simulink® Accelerator.** Accelerate and optimize model performance

**Simulink® Fixed Point.** Design and simulate fixed-point systems

### Platform and System Requirements

For platform and system requirements, visit [www.mathworks.com/products/viprocessing](http://www.mathworks.com/products/viprocessing)



## Sample Blocks

Find the edges in an input image by approximating the gradient magnitude of the image using Canny, Sobel, Prewitt, or Roberts techniques

Downsample or upsample chroma components of a YCbCr signal to reduce the bandwidth or storage requirements

Perform 2-D FIR filtering of input matrix I using filter coefficient matrix H

Perform 2-D cross-correlation between two inputs

Implement the Hough transform for line detection

Perform morphological bottom-hat filtering on an intensity or binary image

Compute the fast Fourier transform in two dimensions (2-D FFT) on a real or complex input

Read video frames and audio samples from a compressed multimedia file (video, audio, or audio + video) (Win32 only)

Estimate motion in a sequence of images

Perform registration on a video stream



The Video and Image Processing Blockset provides a library of basic primitives, advanced video algorithms, and other features for designing real-time video and imaging systems and specifications.

For demos, application examples, tutorials, user stories, and pricing:

- Visit [www.mathworks.com](http://www.mathworks.com)

- Contact The MathWorks directly

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